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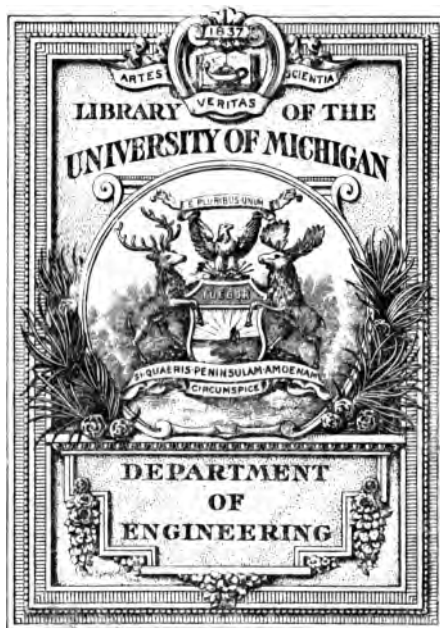
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DEPARTMENT OF COMMERCE AND LABOR
STEAMBOAT-INSPECTION SERVICE

GENERAL RULES AND REGULATIONS

PRESCRIBED BY THE

BOARD OF SUPERVISING INSPECTORS

AS AMENDED

JANUARY, 1906

FURTHER AMENDED BY ACTION OF EXECUTIVE COMMITTEE OF THE BOARD
OF SUPERVISING INSPECTORS, JUNE, 1906

AMENDMENTS APPROVED BY THE SECRETARY OF COMMERCE AND LABOR
MARCH AND JULY 12, 1906

Edition: August 8, 1906



WASHINGTON
GOVERNMENT PRINTING OFFICE
1906

AMENDED STEAMBOAT RULES AND REGULATIONS.

[Department Circular No. 119, Steamboat-Inspection Service.]

DEPARTMENT OF COMMERCE AND LABOR,
OFFICE OF THE SECRETARY,
Washington, July 16, 1906.

To United States supervising and local inspectors, Steamboat-Inspection Service, chief officers of customs, and others concerned:

Under the provisions of section 4405, Revised Statutes of the United States, as amended by the act of Congress approved March 3, 1905, the executive committee of the Board of Supervising Inspectors, Steamboat-Inspection Service, at a called meeting held in June, 1906, amended sections 13, 16, and 20, Rule II; section 33, Rule III; section 13, Rule V; sections 9, 20, 29, and 33, Rule V, and section 3, Rule VIII, of the General Rules and Regulations prescribed by the Board of Supervising Inspectors, which amendments to the rules are hereinafter fully described.

These amendments to the rules, having received the approval of the Secretary of Commerce and Labor, have now the force of law, as provided in section 4405, Revised Statutes, and must be observed accordingly.

The executive committee also approved, for use on vessels, the following-described devices, which have also received the approval of the Secretary of Commerce and Labor, as required by section 4491, Revised Statutes: The Crescent fire extinguisher; the Lyle life-saving shoulder gun, which may be used on all vessels not exceeding 300 gross tons, and the New England Navigation Company's standard boat-disengaging gear.

The executive committee also adopted a temporary certificate of inspection (Form 854), in accordance with section 4421, Revised Statutes, as amended by the act of Congress approved June 11, 1906, which certificate has also received the approval of the Secretary of Commerce and Labor.

Under the provisions of the act of June 11, 1906, when the inspection of a steam or motor vessel is completed, and the inspectors approve the equipment of such vessel throughout, the local inspectors shall, in addition to the certificate of inspection required to be furnished by them to the chief officer of customs, also at once make and subscribe a temporary certificate on the blank form to be furnished for the purpose, which they shall deliver to the master or owner of the vessel, keep a copy thereof in a record book that will be furnished for the purpose, and also furnish a certified copy of the temporary certificate to the chief officer of customs of the district in which the inspection has been made.

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Until the record book is received, local inspectors shall keep on file in their office, on the blank form, a copy of each temporary certificate issued; and when the record book is received, they shall copy said temporary certificates in the record book in the order in which issued.

Temporary certificates shall not be issued to inspected sail vessels, inspected barges, or foreign steamers examined under reciprocal inspection laws, the certificate of inspection or certificate of examination being issued directly to such vessels by the inspectors.

The amendments to the rules, the devices named, and the temporary certificate of inspection above referred to were approved by the Secretary of Commerce and Labor on July 12, 1906.

* * * * *

V. H. METCALF,
Secretary.

OFFICERS OF THE STEAMBOAT-INSPECTION SERVICE.

GEO. UHLER, *Supervising Inspector-General*,
WILLIAM F. GATCHELL, *Chief Clerk*,
Washington, D. C.

SUPERVISING INSPECTORS.

First district.—John Bermingham, San Francisco, Cal.
Second district.—Ira Harris, New York, N. Y.
Third district.—John W. Oast, Norfolk, Va.
Fourth district.—Joseph J. Dunn, St. Louis, Mo.
Fifth district.—John D. Sloane, Dubuque, Iowa.
Sixth district.—Eugene L. Dorsey, Louisville, Ky.
Seventh district.—Samuel R. Crumbaugh, Cincinnati, Ohio.
Eighth district.—Charles H. Westcott, Detroit, Mich.
Ninth district.—James Stone, Cleveland, Ohio.
Tenth district.—John A. Cotter, New Orleans, La.

TERRITORY EMBRACED IN SUPERVISING DISTRICTS.

FIRST DISTRICT embraces all waters and rivers of the United States west of the Rocky Mountains.

SECOND DISTRICT embraces the waters of the Atlantic coast, rivers, and tributaries between the Bay of Passamaquoddy and Cape Charles.

THIRD DISTRICT embraces the waters of the Atlantic coast, rivers, and tributaries between Cape Charles and Cape Sable.

FOURTH DISTRICT embraces the Mississippi River and tributaries from above Greenfield, Mo., up to and including Keokuk, Iowa; the Illinois River below Peoria, and the Missouri River up to the mouth of the Niobrara River at its junction with the Missouri River.

FIFTH DISTRICT embraces the upper Mississippi River and its tributaries above Keokuk, Iowa; the Red River of the North, and that part of the Missouri River and its tributaries above its junction with the Niobrara River, and all that portion of Lake Superior bounded by the States of Minnesota and Wisconsin.

SIXTH DISTRICT embraces the Ohio River and tributaries up to and including Carrollton, Ky., and the Mississippi River and tributaries from Greenville, Miss., up to and including Greenfield, Mo.

SEVENTH DISTRICT embraces the Ohio River and tributaries above Carrollton, Ky.

EIGHTH DISTRICT embraces all the waters of the lakes north and west of Lake Erie, with their tributaries, except that portion of Lake Superior which is bounded by the States of Minnesota and Wisconsin, and also includes the upper portion of the Illinois River down to and including Peoria, Ill.

NINTH DISTRICT embraces all the waters of the River St. Lawrence, Lakes Erie, Ontario, and Champlain, and their tributaries.

TENTH DISTRICT embraces the coast and tributary waters of the Gulf of Mexico, between Cape Sable and the mouth of the Rio Grande, and the Mississippi River and tributaries to Greenville, Miss.

LOCAL INSPECTORS.

District.	Of hulls.	Of boilers.	Residence.
FIRST	O. F. Bolles	John K. Bulger	San Francisco, Cal.
	Thomas P. Deering, assistant	John E. Wynn, assistant	Do.
	James Guthrie, assistant	Joseph P. Dolan, assistant	Do.
	William Howe, assistant	Carl F. Lehnners, assistant	Do.
	Edward S. Edwards	Geo. F. Fuller	Portland, Oreg.
	Bion B. Whitney	Robert A. Turner	Seattle, Wash.
	Evan Griffiths, assistant	Harry C. Lord, assistant	Do.
	Frank H. Turner, assistant	John B. Wolters, assistant	Do.
	Edward G. Rouse, assistant	Thomas Short, assistant	Do.
	Donald S. Ames, assistant ¹	George Q. Weldin, assistant ¹	Do.
	Geo. H. Whitney	Frank H. Newhall	Juneau, Alaska.
	Austin N. Walton	Thomas J. Heeney	St. Michael, Alaska
SECOND	Henry M. Seeley	Theodore T. Mercereau	New York, N. Y.
	Geo. T. Charlton, assistant	Wm. G. Fenwick, assistant	Do.
	Frank J. Smith, assistant	Wm. H. Powers, assistant	Do.
	George S. Tuthill, assistant	Richard F. Wilson, assistant	Do.
	Thos. H. Foster, assistant	Charles Stewart, assistant	Do.
	Joseph Watkinson, assistant	John W. Fleming, assistant	Do.
	Albert H. Terry, assistant	John J. McCarthy, assistant	Do.
	Peter C. Petrie, assistant	John W. Waters, assistant	Do.
	Cornelius H. Smith, assistant	John E. Gunn, assistant	Do.
	Everett J. Millikin, assistant	John L. Crone, assistant	Do.
	Henry M. Taylor, assistant	Daniel J. Dougherty, assistant ²	Do.
	Hector R. Campbell, assistant	Alfred G. Knights, assistant	Do.
	Alan S. Johnstone, assistant	Frank C. Williams, assistant	Do.
	Humphrey Jones, assistant	George F. Coleman, assistant	Do.
	Wm. A. Carleton	Andrew J. Savage	Boston, Mass.
	Charles F. Owen, assistant	Wm. M. Gilman, assistant	Do.
	Henry L. Thompson, assistant	Newell A. Perry, assistant	Do.
	Redford A. Sargent	David H. Howard	Philadelphia, Pa.
	Harry S. Miller, assistant	Samuel A. Mills, assistant	Do.
	Hannon M. Power, assistant	John E. Wilson, assistant	Do.
	Hugh MacPherson, assistant	Clement A. Mattson, assistant	Do.
	Wm. E. Withey	John Stewart	New London, Conn
	Robert B. Keller	Andrew Gaul	Albany, N. Y.
	George A. Pollister	John H. Trevett	Portland, Me.
	Edward Wilcox	Chas. A. Potter	Providence, R. I.
	Chas. O. Cousins	Walter L. Blaisdell	Bangor, Me.
THIRD	Victor E. Wright	Frederick L. Dennis	New Haven, Conn.
	Robert E. Tapley	Edward W. Bray	Norfolk, Va.
	Alexander Calcott, assistant	Thomas J. Hanlon, assistant	Do.
	Chas. W. Wright	Edwin F. White	Baltimore, Md.
	Richard A. Dunn, assistant	Michael Stanton, assistant	Do.
	August E. Blom, assistant	Henry L. Simpson, assistant	Do.
	Lewis F. Powell, assistant	George L. Taylor, assistant	Do.
	.....	Edward G. Allen, assistant ³	Do.
	Fred. B. Rice	John T. Borden	Charleston, S. C.
	Wm. G. Lee	Edward B. Fitzgerald	Savannah, Ga.
FOURTH	Wm. A. Shaw	Chas. A. Spencer	Jacksonville, Fla.
FIFTH	Archibald Gordon	Wm. J. Macdonald	St. Louis, Mo.
SIXTH	George B. Knapp	James I. Cary	Dubuque, Iowa.
	John Monaghan	Michael F. Chalk	Duluth, Minn.
	John E. Abraham .....	.....	Louisville, Ky.
	Richard H. Williams	John H. Moore	Evansville, Ind.
	George M. Green .....	.....	Nashville, Tenn.
	Hiram O. Brazee	Henry C. Waltz	Memphis, Tenn.
SEVENTH	John K. Peyton	George W. Dameron	Cincinnati, Ohio.
	Wm. H. Clark	Charles G. Thomas	Point Pleasant, W. Va.
	Isaac B. Williams	George H. Atkinson	Pittsburg, Pa.
EIGHTH	Frederick J. Meno	John H. Galwey	Detroit, Mich.
	Ira B. Mansfield	Roy L. Peck	Chicago, Ill.
	George W. Pardee	Charles C. Eckliff	Grand Haven, Mich.
	Charles M. York	Charles M. Gooding	Marquette, Mich.

¹ Detailed to Portland, Oreg.

² Detailed to Pittsburg, Pa.

³ Detailed to Coatesville, Pa.

LOCAL INSPECTORS—Continued.

District.	Of hulls.	Of boilers.	Residence.
EIGHTH	Frank W. Van Patten	William A. Collins	Milwaukee, Wis.
	Thos. W. Swift, assistant	Perry N. Knaggs, assistant	Do.
	Henry C. McCallum, assistant ¹	George M. Milne, assistant ¹	Do.
	Robert Reid, assistant ²	William Nicholas, assistant ²	Do.
	Willis W. Stewart	Frank Van Liew	Port Huron, Mich.
NINTH	Nils B. Nelson	James McGrath	Cleveland, Ohio.
	Frederick L. R. Pope	Joseph G. Schumacher	Buffalo, N. Y.
	James M. Todd, assistant	Wm. F. Nolan, assistant	Do.
	Thomas W. Gould, assistant ³	John B. Hayward, assistant ³	Do.
	Byron J. Holt	Andrew I. Goodhue	Burlington, Vt.
	John R. Molther	Robert Chestnut	Oswego, N. Y.
	Charles A. Potter	Wm. F. Fletz	Toledo, Ohio.
TENTH	Benjamin F. Kelly	Cecil N. Bean	New Orleans, La.
	Robert J. McBride, assistant	Robert F. Hall, assistant	Do.
	George H. Whiteside	Alton Pierce	Apalachicola, Fla.
	Robert G. Murray	Felix Smith	Galveston, Tex.
	Samuel Taylor	Eugene O'Brien	Mobile, Ala.

¹ Detailed to Detroit, Mich.² Detailed to Chicago, Ill.³ Detailed to Cleveland, Ohio.*Clerk to Supervising Inspector, Second District.*

Walter Richards, New York, N. Y.

Clerks to local boards.

Thomas R. Craigie, San Francisco, Cal.

James J. Sullivan, San Francisco, Cal.

Arthur F. Merrill, Portland, Oreg.

Willis H. Rooks, Seattle, Wash.

Wesley E. Walker, Seattle, Wash.

———, Juneau, Alaska.

Gustavus E. Hart, St. Michael, Alaska.

Frank J. Dunlea, New York, N. Y.

Harry S. Eckert, New York, N. Y.

John Groener, jr., New York, N. Y.

Harry P. Parker, New York, N. Y.

D. J. Phelan, New York, N. Y.

Thomas B. Martin, New York, N. Y.

William C. Osborne, New York, N. Y.

George A. Copeland, Boston, Mass.

John M. B. Kelly, Boston, Mass.

James E. Gallagher, Philadelphia, Pa.

William E. McFarland, Philadelphia, Pa.

John J. McIntee, New London, Conn.

Thomas J. Reilly, Albany, N. Y.

W. H. O'Brien, Portland, Me.

Chas. W. Loux, Providence, R. I.

John S. Conway, New Haven, Conn.

George M. Kitzmiller, Norfolk, Va.

———, Norfolk, Va.

Chas. L. Wiegand, Baltimore, Md.

George B. Sprow, jr., Baltimore, Md.

Harry F. Kabernagel, Charleston, S. C.

George A. Gregory, Savannah, Ga.

James N. Stover, Jacksonville, Fla.

Henry E. Folluo, St. Louis, Mo.

Wm. R. Oliver, Dubuque, Iowa.

Donald McLennan, Duluth, Minn.

Victor M. Grubb, Pittsburg, Pa.

Alfred J. Doyle, Detroit, Mich.

Harry B. Lockwood, Chicago, Ill.

Elmer C. Hurless, Grand Haven, Mich.

Elmer H. Beckett, Marquette, Mich.

Lee R. Whitney, Milwaukee, Wis.

David McCarron, Port Huron, Mich.

John E. Mulroy, Buffalo, N. Y.

Harold R. Bassett, Buffalo, N. Y.

Edward Lawlor, Cleveland, Ohio.

Charles F. Hager, Oswego, N. Y.

Edward M. Mansuy, Toledo, Ohio.

Paul W. Peavy, New Orleans, La.

Walter S. Otto, New Orleans, La.

J. Brooks Clark, Mobile, Ala.

GENERAL RULES AND REGULATIONS.

RULE I.—BOILER PLATE.

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STAMPS.

1. Every iron or steel plate intended for the construction of boilers to be used on steam vessels shall be stamped by the manufacturer in at least five places and in the following manner: §4431, R. S.

At the corners, at a distance of about 8 inches from the edges, and at or near the center of the plate, with the name of the manufacturer, the place where manufactured, and the number of pounds tensile stress it will bear to the sectional square inch, which must not be less than 45,000 pounds for iron or 50,000 pounds for steel: *Provided, however,* That where the original plate, as rolled, is cut into smaller plates, or sheets, each sheet or plate thereof

- (I, 1) shall bear at least one stamp in such location as will best insure identification of the plate or sheet when assembled in construction.
- § 4431, R. S. 2. Any plate stamped with a higher tensile strength than shown by the test hereinafter prescribed may be restamped by the manufacturer to the tensile strength of the sample, provided it is within the limits prescribed by these rules; such restamping to be done previous to the use of the plates in the manufacture of marine boilers.
- §§ 4431, 4433, R. S. 3. Whenever inspectors shall find a plate of iron or steel with stamps differing as to the tensile strength of the material they shall rate the tensile strength of the same in accordance with the lowest stamp found thereon.
- § 4430, R. S. 4. Boilers built since February 28, 1872, of material stamped and tested according to the requirements of section 4430, Revised Statutes, and having a record thereof in the office of the local inspectors in the district where the boiler was built or intended to be used, may be used for marine purposes, notwithstanding that such boilers may have been used for other purposes: *Provided*, That in the judgment of the local inspectors they are deemed safe for the purpose.
- § 4431, R. S. 5. If the plates possess the physical, chemical, and other lawful qualities required by these rules, the inspector making the test shall stamp the plate near the manufacturer's stamp, with the official stamp of the United States Steamboat-Inspection Service, and with the initials of his name and a serial number.
- Plates may be tested and inspected at the mills for repairs to marine boilers or to be carried in stock, the report of such test to be in duplicate, one copy to be furnished through the supervising inspector to the local inspectors in the district where the purchaser of such material is located, and the other to the purchaser, who shall deliver a copy of the same to the parties using the material, who, in turn, shall submit the same to the local inspectors in the district where the material is to be used, before being assembled in the boiler. Steamers carrying such repair material to be used in emergencies shall carry the record of each sheet of such material on board.

TESTING.

- §§ 4430, 4431, R. S. 6. After June 30, 1905, every iron or steel plate subject to tensile strain, to be used in the construction of boilers for steamers subject to the provisions of Title LII, shall be inspected and tested by an inspector duly authorized under the provisions of said title, as follows:
- All material must be free from laminations, cracks, scabs, or other defects tending to reduce its strength.
- All plates which show defects in these or other respects shall be rejected.
- From each plate as first rolled from the billet, bloom, or ingot there shall be taken four test pieces, two for the

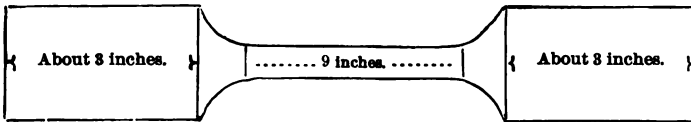
tensile test from diagonal corners and the other two for the bending test from the other diagonal corners, as hereinafter described.

(I, 6)

All the pieces shall be prepared so that the skin shall not be removed, the edges only planed or shaped.

In no case shall test pieces be prepared by annealing or reduced in size by hammering.

Tensile-test pieces shall be at least 16 inches in length, from $1\frac{1}{2}$ to $3\frac{1}{2}$ inches in width at the ends, which ends shall join by an easy fillet, a straight part in the center of at least 9 inches in length and 1 inch in width, in form according to the following diagram, marked with light prick punch marks at distances 1 inch apart, spaced so as to give 8 inches in length: *Provided, however,* That where samples are tested on the testing machines of the Steamboat-Inspection Service the test pieces shall not have a greater width on the ends than 2 inches.



STEEL PLATES.

7. Only steel plates manufactured by what is known as the basic or acid open-hearth processes will be allowed to be used in the construction of boilers for marine purposes, and the manufacturer shall furnish a certificate with each order of steel tested, stating the technical process by which said steel was manufactured. This is not intended to apply to plates used in the construction of Bessemer steel tubes. § 4430, R. S.

No plate made by the acid process shall contain more than .06 per cent of phosphorus and .04 per cent of sulphur, and no plate made by the basic process shall contain more than .04 per cent of phosphorus and .04 per cent of sulphur, to be determined by analysis by the manufacturers, verified by them, and a copy furnished the inspector for each order tested; which analysis shall, if deemed expedient by the Supervising Inspector-General, be verified by an outside test at the expense of the manufacturer of the plate.

For steel plates the sample must show, when tested, a tensile strength not lower than 50,000 pounds and not more than 75,000 pounds per square inch of section; but on boilers whose construction is commenced after June 30, 1905, where the plate will come in contact with fire, either in use or in course of construction of the boiler, the tensile strength shall not be more than 70,000 pounds per square inch of section. No plate shall be stamped with a greater tensile strength than 70,000 pounds. Such sample must also show an elongation of at least 25 per cent in a length of 2 inches for thickness up to one-fourth inch, inclusive;

- (I, 7) in a length of 4 inches for over one-fourth to seven-sixteenths inch, inclusive; in a length of 6 inches for all plates over seven-sixteenths inch. The sample must also show a reduction of sectional area as follows:

At least 50 per cent for thickness up to one-half inch, inclusive; 45 per cent for thickness over one-half to three-fourths inch, inclusive, and 32.5 per cent for thickness over three-fourths of an inch.

Quenching and bending test.—Quenching and bending test pieces shall be at least 12 inches in length and from 1 to 3½ inches in width. The sides where sheared or planed must not be rounded, but the edges may have the sharpness taken off with a fine file. The test piece shall be heated to a cherry red (as seen in a dark place) and then plunged into water at a temperature of about 82° F. Thus prepared the sample shall be bent to a curve the inner radius of which is not greater than one and one-half times the thickness of the sample, without cracks or flaws. The ends must be parallel after bending.

IRON PLATES.

§ 4630, R. S.

8. For iron plates the sample must show, when tested, a tensile strength not lower than 45,000 pounds and not more than 60,000 pounds per square inch of section. It must also show an elongation of at least 15 per cent in a length of 8 inches. The sample must also show a reduction of sectional area as follows: For samples showing 45,000 pounds tensile strength, 15 per cent, and for each additional 1,000 pounds tensile strength up to 55,000 pounds add 1 per cent. For samples over 55,000 pounds to 60,000 pounds tensile strength, 25 per cent only will be required.

Bending test.—Bending test pieces shall be at least 12 inches in length and from 1 to 3½ inches in width. The sides where sheared or planed must not be rounded, but the edges may have the sharpness taken off with a fine file.

Thus prepared, the sample shall be bent cold to an angle of 90° to a curve, the inner radius of which is not greater than one and one-half times the thickness of the sample, without cracks or flaws.

RECORD OF TESTS.

(I)

9. All tests made of boiler material must be recorded upon a table of the following form: § 4405, R. S.

Tensile tests of samples of material intended to be employed in the construction of boilers of steam vessels made on ——— testing machine.

Date when tests were made.	From whom samples were obtained.	By whom tested.	Material, iron or steel.	Stamp or label on samples, which must be the same as stamps on the materials from which they are taken.	Numbers on plate.	Widths of samples, expressed in decimals of an inch.	Thickness of samples, expressed in decimals of an inch.	Strain at which each sample parted.	Reduced width of sample.	Reduced thickness of sample.	Reduction of area, per cent.	Length of straight part in center of test piece.	Elongation, percentage of.	Boiler being constructed by—

The gauge to be employed by inspectors to determine the thickness of boiler plates and the widths in the table will be any standard American gauge furnished by the Department of Commerce and Labor.

[Form 935.]

AFFIDAVIT OF MANUFACTURER OF MARINE STEAM BOILERS CONSTRUCTED OF MATERIAL TESTED AT THE MILLS. § 4405, R. S.

STATE OF ———, County of ———, ss:

On this ——— day of ———, A. D. 190—, personally appeared before me, ———, a notary public in and for the county of ——— and State of ———, Mr. ———, who, being duly sworn, deposes and says that he is ———, of ———, boiler manufacturer, and has contracted to build — marine boiler for ———, of ———, plate stamped ——— T. S., from ——— plate manufactured by ———, of ———, which plate was tested at the mills by a United States assistant inspector, as provided in the act of Congress approved January 22, 1894, each of said plates having stamped thereon the words "U. S. assistant inspector" and the initials, ———, and numbered as follows: ———.

And no plate for shell or other part of boiler subject to tensile strain, other than herein specified, will be used in the construction of said boiler, the dimensions of which will be: Length, ———; diameter, ———.

Rivet holes in the shells, heads, and flanges of same, steam and mud drums, and holes for stay bolts, drilled and no part punched ———. Number of tubes, ———; length, ———; thickness, ———; diameter, ———. Number of flues, ———; length, ———; thickness, ———; diameter, ———. Number of furnaces, ———; length, ———; thickness, ———; diameter, ———. Kind of furnaces, ———; round, ———; corrugated, ———; flat sides, ———; thickness of plates of cylindrical shell of boiler, ———; thickness of side sheets in flat side of furnace, ———; thickness of flat top sheet of back connection, ———; thickness of plates of cylindrical shell of back connection, ———; thickness of material of boiler heads, ———; thickness of tube sheets, ———; thickness of plates of shell of steam chimney, ———; thickness of plates in lining of steam chimney, ———; thickness of side sheets, ———; kind of rivets (iron or steel), ———; diameter of rivet holes, ———; pitch of rivets, ———; pressure of steam boiler is to be inspected for, ———; and of the style known as ———, to be used upon the steamer ———.

(Signature) ———.

Sworn to and subscribed before me this ——— day of ———, 190—.

[NOTARY'S SEAL.]

Notary Public.

(NOTE.—Inspectors will not accept this affidavit without the data required, unless accompanied by a satisfactory explanation in writing, to be filed with the affidavit.)

, 9)

[Form 92A.]

i. R. S.

AFFIDAVIT OF MANUFACTURER OF MARINE STEAM BOILERS.

STATE OF _____, County of _____, ss:

On this _____ day of _____, A. D. 190-, personally appeared before me, _____, a notary public in and for the county of _____ and State of _____, Mr. _____, who, being duly sworn, deposes and says that he is _____, of _____, boiler manufacturer, and that the accompanying samples of _____, manufactured by _____, of _____, were cut from plates stamped _____ T. S., which are to be used in the construction of _____ marine boiler for _____; and no plate for shell or other part of boiler subject to tensile strain of less tensile strength or quality than herein specified will be used in the construction of said boiler, the dimensions of which will be: Length, _____; diameter, _____. Rivet holes in the shells, heads and flanges of same, steam and mud drums, and holes for stay bolts, drilled and no part punched, _____. Number of tubes, _____; length, _____; thickness, _____; diameter, _____. Number of flues, _____; length, _____; thickness, _____; diameter, _____. Number of furnaces, _____; length, _____; thickness, _____; diameter, _____. Kind of furnaces, _____; round, _____; corrugated, _____; flat side, _____. Thickness of plates of cylindrical shell of boiler, _____; thickness of side sheets in flat side of furnace, _____; thickness of plates of cylindrical shell of back connection, _____; thickness of flat top sheet of back connection, _____; thickness of material of boiler heads, _____; thickness of tube sheets, _____; thickness of plates of shell of steam chimney, _____; thickness of plates in lining of steam chimney, _____; thickness of side sheets, _____; kind of rivets (iron or steel), _____; diameter of rivet holes, _____; pitch of rivets, _____; pressure of steam boiler is to be inspected for, _____; and of the style known as _____, to be used upon the steamer _____.

(Signature) _____.

Sworn to and subscribed before me this _____ day of _____, 190-.

[NOTARY'S SEAL.] _____,

Notary Public.

Inspectors will not accept this affidavit unless the data required is given, unless accompanied by a satisfactory explanation in writing, to be filed with the affidavit.

Inspectors may make requisition on the Department for the necessary supply of blank affidavits for the use of boiler manufacturers.

FOREIGN-BUILT BOILERS.

i. R. S.

10. Boilers of foreign-built vessels admitted to American registry shall be deemed, if of iron, to have a tensile strength of 45,000 pounds to the sectional square inch; and, if of steel, to have a tensile strength of 50,000 pounds to the square inch: *Provided, however,* That when the local inspectors of steamboats are furnished with an authentic copy of the tensile tests of the material entering into the construction of such boilers, the boilers shall be inspected and tested in accordance with the rules and regulations of the Board of Supervising Inspectors and allowed a steam pressure in accordance with the tensile strength of the material and general condition of the boilers.

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§ 4405, R. S.

1. The manufacturer of any boiler to be used for marine purposes shall furnish the inspectors of the district where such boiler or boilers are to be inspected duplicate blue-prints or tracings descriptive of same for their approval, one of which shall be kept on file in the office of the local inspectors and the other returned to the manufacturer. Where more than one boiler is made from a similar design, a drawing of which is on file in the local inspector's office, if made at a different date, a reference to such drawing on file is all that shall be required. The manufacturer shall also furnish the inspectors a written statement of the kind of material and size of rivets to be used in the construction of such boiler, the size and longitudinal and diagonal pitch of the rivet holes in same, and distance from center of rivet holes to edge of plate, as well as the affidavit required by section 9 of Rule I, subscribed to either by himself or

CYLINDRICAL SHELLS.

2. The working steam pressure allowable on cylindrical shells of boilers constructed of plates inspected as required by these rules, when single riveted, shall not produce a strain to exceed one-sixth of the tensile strength of the iron or steel plates of which such boilers are constructed; but where the longitudinal laps of the cylindrical parts of such boilers are double riveted, and the rivet holes for such boilers have been fairly drilled, an addition of 20 per cent to the working pressure provided for single riveting will be allowed. § 4433, R. S.

The pressure for any dimension of boilers not found in the table annexed to these rules must be ascertained by the following rule, viz:

Multiply one-sixth of the lowest tensile strength found stamped on any plate in the cylindrical shell by the thickness—expressed in inches or parts of an inch—of the thinnest plate in the same cylindrical shell, and divide by the radius or half diameter—also expressed in inches—and the result will be the pressure allowable per square inch of surface for single riveting, to which add 20 per cent for double riveting, when all the rivet holes in the shell of such boiler have been “fairly drilled” and no part of such holes has been punched.

3. Plates of iron or steel, used in the construction of boilers, extending beyond the cylindrical shell to the front of the boiler over the furnaces, shall extend at least 12 inches below the center of the shell, and shall not be of less tensile strength or thickness than the adjoining sheets in the cylindrical portions of the shell, and the sheets forming the shell shall be rolled to form of shell with the grain of the material. § 4418, R. S.

RIVET HOLES AND BUTT STRAPS.

4. All boilers built for marine purposes shall be required to have the rivet holes in the shells, heads, and flanges of same, steam and mud drums, and holes for stay bolts and tubes fairly drilled and no part of such holes shall be punched. §§ 4418, 4433, R. S.

The diameter of rivets, rivet holes, distance between centers of rivets, and distance from centers of rivets to edge of lap for different thicknesses of plates for single and double riveting shall be determined by the following rule:

(See Appendix, pp. 111–117.)

5. Where butt straps are used in the construction of marine boilers, the straps for single butt strapping shall in no case be less than the thickness of the shell plates; and

- (II, 5) where double butt straps are used, the thickness of each shall in no case be less than five-eighths ($\frac{5}{8}$) the thickness of the shell plates.

DRILLING TO DETERMINE THICKNESS.

- § 4430, R. S. 6. Any boiler ten years old or more shall, at the first annual inspection thereafter, be drilled at points near the water line and at bottom of shell of boiler, or such other points as the local inspectors may direct, to determine the thickness of such material at those points; and the steam pressures allowed shall be governed by such ascertained thickness and the general condition of the boiler.

HYDROSTATIC PRESSURE.

- § 4418, R. S. 7. The hydrostatic pressure applied must be in the proportion of 150 pounds to the square inch to 100 pounds to the square inch of the steam pressure allowed, and the inspector, after applying the hydrostatic test, must thoroughly examine every part of the boiler.

In applying the hydrostatic test to boilers with a steam chimney the test gauge should be applied to the water line of such boilers.

DONKEY BOILERS.

- § 4418, R. S. 8. Every seagoing steamer carrying passengers for hire shall be supplied with an auxiliary or donkey boiler of sufficient capacity to work the fire pumps, and such boilers shall not be placed below the lower decks, except on single-deck vessels, on any steamer hereafter built or applying for first inspection as a passenger steamer.

Donkey boilers must be inspected in the same manner as the main boilers.

STAYS.

- §§ 4405, 4418, R. S. 9. The maximum stress in pounds allowable per square inch of cross-sectional area for stays used in the construction of marine boilers, when same are accurately fitted and properly secured, shall be ascertained by the following formula:

$$P = \frac{A \times C}{a}$$

Where P=working pressure in pounds.

A=least cross-sectional area of stay in inches.
a=area of surface supported by one stay, in inches.

C=a constant, 6,000, 7,000, 8,000, 9,000, as the case may be.

C=9,000 for tested steel stays exceeding $2\frac{1}{2}$ inches in diameter.

Where $C=8,000$ for tested steel stays $1\frac{1}{4}$ inches and not exceeding $2\frac{1}{4}$ inches in diameter, when such stays are not forged or welded. The ends, however, may be upset to a sufficient diameter to allow for the depth of the thread. The diameter shall be taken at the bottom of the thread, provided it is the least diameter of the stay. All such stays after being upset shall be thoroughly annealed. (II, 9)

$C=8,000$ for a tested Huston or similar type of brace, the cross-sectional area of which exceeds 5 square inches.

$C=7,000$ for such tested braces when the cross-sectional area is not less than 1.227 and not more than 5 square inches, provided such braces are prepared at one heat from a solid piece of plate without welds.

$C=6,000$ for all stays not otherwise provided for

EXAMPLE.

Required the working pressure of a stay 1 inch in diameter, pitched 6 inches by 6 inches center to center.

$$\text{Working pressure} = \frac{(1 \times 1 \times .7854) \times 6,000}{6 \times 6} = 130.9 \text{ pounds.}$$

The diameter of a screw stay shall be taken at the bottom of the thread, provided it is the least diameter of the stay.

For all stays the least sectional area shall be taken in calculating the stress allowable.

All screw stay bolts shall be drilled at the ends with a one-eighth inch hole to at least a depth of one-half inch beyond the inside surface of the sheet. Stays through laps or butt straps may be drilled with larger hole to a depth so that the inner end of said larger hole shall not be nearer than the thickness of the boiler plates from the inner surface of the boiler.

Such screw stay bolts, with or without sockets, may be used in the construction of marine boilers where fresh water is used for generating steam: *Provided, however,* That screw stay bolts of a greater length than 24 inches will not be allowed in any instance, unless the ends of said bolts are fitted with nuts. Water used from a surface condenser shall be deemed fresh water.

The sectional area of pins to resist double shear and bending, accurately fitted and secured in crow feet, sling, and similar stays, shall be at least equal to required sectional area of the brace. Breadth across each side and depth to crown of eye shall be not less than .35 to .55 of diameter of pin. In order to compensate for inaccurate distribution the forks should be proportioned to support two-thirds of the load, thickness of forks to be not less than .66 to .75 of the diameter of pins.

(II, 9) The combined sectional area of rivets used in securing tee irons and crow feet to shell, said rivets being in tension, shall be not less than the required sectional area of brace. To insure a well-proportioned rivet point, the total length of shank should closely approximate the grip plus 1.5 times the diameter of the shank. All rivet holes shall be drilled; distance from center of rivet hole to edge of tee irons, crow feet, and similar fastenings shall be so proportioned that the net sectional areas through sides at rivet holes shall equal the required rivet section; rivet holes to be slightly countersunk in order to form a fillet at point and head.

All steel bars used as stays or braces and braces of the Huston type to be allowed a stress of 7,000, 8,000, or 9,000 pounds per square inch of section shall be tested by the inspectors, in lots not to exceed 50 bars, in the following manner: Inspectors shall select one bar or brace from each lot and bend one end of such bar or brace cold to a curve, the inner radius of which is equal to one and one-half times the diameter of the test bars or the thickness of the brace, as the case may be, without flaws or cracks; and should any such test bar or brace fail in the test, the lot from which the test bar or brace was taken shall not be allowed to be used in the construction of marine boilers.

Boiler manufacturers desiring to use tested steel stays or braces shall be required to furnish the inspectors with the following form of affidavit duly filled in:

[Form 937.]

STATE OF ———, County of ———, ss.:

Personally appeared before me, a notary public for and in the county of ——— and State of ———, Mr. ———, who, being first duly sworn, deposes and says that he is the ——— of the steam boiler works situated at ———, and known as the ———, and that the lot or lots of steel bars from which the test bars were taken and tested by the inspector on the ——— day of ———, 190—, and allowed for use in the steam boiler— to be constructed for the steamer ———, and to be allowed a strain not to exceed ——— pounds per square inch of section as a working steam pressure, will be used in the construction of the boiler— for the steamer ———, and no material for any braces, stays, or stay bolts required to carry a strain equal to ——— pounds per square inch of section will be used as braces, stays, or stay bolts in the construction of the boiler— for the said steamer unless tested by the inspector and approved by him in accordance with the requirements of law.

Sworn to and subscribed before me this ——— day of ———, 190—.

[NOTARY'S SEAL.]

Notary Public.

TOPS OF COMBUSTION CHAMBERS AND BACK CONNECTIONS.

§4418 R. S.

10. The tops of combustion chambers and back connections in all boilers whose construction is commenced after June 30, 1906, subject to pressure of 160 pounds per square inch and over shall be suspended from top of shell. Where

girders are used in the construction of tops of combustion chambers and back connections, such girders shall be suspended by braces from top of shell to girder, each of such braces to be of a sectional area not less than twice the sectional area of each of the bolts suspending the top of combustion chambers from the girder. (II, 10)

Formula for girders over back connection and for other surfaces:

$$\text{Working pressure} = \frac{C \times d^2 \times T}{(W - P) \times D \times L}$$

Where W = width of combustion box in inches.

P = pitch of supporting bolts in inches.

D = distance between girders from center to center in inches.

L = length of girder in feet.

d = depth of girder in inches.

T = thickness of girder in inches.

C = 550 when the girder is fitted with one supporting bolt.

C = 825 when the girder is fitted with two or three supporting bolts.

C = 935 when the girder is fitted with four supporting bolts.

EXAMPLE.

Given W = 34 inches, P = 7.5 inches, D = 7.75 inches, L = 2.927 feet, d = 7.5 inches, T = 2 inches, C = 825, then, substituting in formula,

$$\text{Working pressure} = \frac{825 \times 7.5 \times 7.5 \times 2}{(34 - 7.5) \times 7.75 \times 2.927} = 154.3 \text{ pounds.}$$

FLAT SURFACES.

11. The maximum stress allowable on flat plates supported by stays shall be determined by the following formula: § 4418, R. S.

All stayed surfaces formed to a curve the radius of which is over 21 inches, excepting surfaces otherwise provided for, shall be deemed flat surfaces.

$$\text{Working pressure} = \frac{C \times T^2}{P^2}$$

Where T = thickness of plates in sixteenths of an inch.

P = *greatest* pitch of stays in inches.

C = 112 for plates $\frac{1}{8}$ of an inch thick and under.

C = 120 for plates over $\frac{1}{8}$ of an inch thick.

C = 140 for plates fitted with stays having one nut on the inside and one nut on the outside of plate.

(II, 11) Where $C=160$ for plates fitted with washers which have a thickness of at least .5 of the thickness of the plate and a diameter of at least .5 of the greatest pitch of the stay, riveted to the outside of the plates, and stays having one nut inside of the plate and one nut outside of the washer: T will then equal 80 per cent of the combined thickness of the plate and washer.

$C=200$ for plates fitted with doubling plates which have a thickness equal to at least .5 of the thickness of the plate reenforced and covering the full area braced (up to the curvature of the flange, if any), riveted to either the inside or outside of the plate, and stays having one nut outside and one inside of the plates: *Provided, That*—the washers or doubling plates are riveted to the plates with rivets spaced and of sufficient sectional area as already provided for stays and flat surfaces, the pitch to be determined by the thickness of the washer or the doubling plate. T will then equal 80 per cent of the combined thickness of the two plates.

$C=200$ for plates fitted with tees or angle bars having a thickness of at least $\frac{3}{4}$ the thickness of plate and depth of webs at least $\frac{1}{4}$ of the greatest pitch of the stays, and riveted on the inside of the plates, and stays having one nut inside bearing on washers fitted to the edges of the webs that are at right angles to the plate. T will then equal 80 per cent of the combined thickness of web and plate.

EXAMPLES.

Requiring the working pressure allowed for flat plates $\frac{7}{16}$ of an inch thick, stayed 5-inch by 6-inch centers:

$$\text{Working pressure} = \frac{112 \times 49}{36} = 152 \text{ pounds.}$$

For a plate $\frac{3}{4}$ of an inch thick, stayed 9-inch by 10-inch centers:

$$\text{Working pressure} = \frac{120 \times 144}{100} = 172 \text{ pounds.}$$

For a plate $\frac{3}{4}$ of an inch thick, supported by stays with double nuts, 10-inch by 12-inch centers:

$$\text{Working pressure} = \frac{140 \times 144}{144} = 140 \text{ pounds.}$$

For a plate $\frac{1}{2}$ inch thick, with washers $\frac{3}{8}$ of an inch thick, (II, 11)
 stayed 10-inch by 12-inch centers:

$$\text{Working pressure} = \frac{160 \times 125.44}{144} = 139 \text{ pounds.}$$

For a plate $\frac{3}{8}$ of an inch thick, with doubling plate $\frac{1}{8}$ of
 an inch thick, stayed 14-inch by 14-inch centers:

$$\text{Working pressure} = \frac{200 \times 184.96}{196} = 188 \text{ pounds.}$$

For a plate $\frac{3}{8}$ of an inch thick, with tees or angle bars
 one-half of an inch thick, stayed 14 by 14 inch centers:

$$\text{Working pressure} = \frac{200 \times 207.36}{196} = 211 \text{ pounds.}$$

MAXIMUM PITCH.

Ten and one-half inches from center to center of stays shall be the greatest distance allowable when the plates are exposed to the impact of the heat or flame.

Eighteen inches from center to center of stays shall be the greatest distance allowable in any case.

REQUIREMENTS FOR HEADS.

12. All plates used as heads, when new and made to § 4418, R. S
 practically true circles, and as described below, shall be allowed a steam pressure in accordance with the following formula:

CONVEX HEADS.

$$P = \frac{T \times S}{R}$$

Where P=steam pressure allowable in pounds.

T=thickness of plate in inches.

S=one-sixth of the tensile strength.

R=one-half of the radius to which the head is bumped.

Add 20 per cent to P when the head is double riveted to the shell and the holes are fairly drilled.

CONCAVE HEADS.

For concave heads the pressure allowable will be .6 times the pressure allowable for convex heads.

NOTE.—To find the radius of a sphere of which the bumped head forms a part, square the radius of head, divide this by the height of bump required; to the result add height of bump, which will equal diameter of sphere, one-half of which will be the required radius.

(II, 12)

EXAMPLE.

Required the working pressure of a convex head of a 54-inch radius, material 60,000 pounds tensile strength and $\frac{1}{2}$ of an inch thick, double riveted and holes fairly drilled. Substituting values, we have

$$P = \frac{.5 \times 16,000}{27} + 20 \text{ per cent} = 185 + 37 = 222 \text{ pounds.}$$

The pressure allowable on a concave head of the same dimensions would be:

$$222 \times .6 = 133 \text{ pounds.}$$

Bumped heads may contain a manhole opening flanged inwardly, when such flange is turned to a depth of three times the thickness of the material in the head.

FLAT HEADS.

Where flat heads do not exceed 20 inches in diameter they may be used without being stayed, and the steam pressure allowable shall be determined by the following formula:

$$P = \frac{C \times T^2}{A}$$

Where P=steam pressure allowable in pounds.

T=thickness of material in sixteenths of an inch.

A=one-half the area of head in inches.

C=112 for plates $\frac{1}{8}$ of an inch and under.

C=120 for plates over $\frac{1}{8}$ of an inch.

Provided, The flanges are made to an inside radius of at least $1\frac{1}{2}$ inches.

EXAMPLE.

Required the working pressure of a flat head 20 inches in diameter and $\frac{3}{4}$ of an inch thick. Substituting values, we have

$$P = \frac{120 \times 144}{157} = 110 \text{ pounds.}$$

TUBES.

(II)

13. Lap-welded tubes, used in boilers whose construction was commenced after June 30, 1905, having a thickness of material according to their respective diameters shall be allowed a working pressure as prescribed in the following table, provided they are deemed safe by the inspectors: § 4418, R. S.

Outside diameter.	Thickness of material.	Greatest length allowable.	Maximum pressure allowable.
<i>Inches.</i>	<i>Inch.</i>	<i>Feet.</i>	<i>Pounds.</i>
1	.072	Any length.	225
1 $\frac{1}{4}$	.072	.....do.....	225
1 $\frac{1}{2}$	.083	.....do.....	225
1 $\frac{3}{4}$	.095	.....do.....	225
2	.095	.....do.....	225
2 $\frac{1}{4}$	.095	.....do.....	225
2 $\frac{1}{2}$	.109	.....do.....	225
2 $\frac{3}{4}$	.109	.....do.....	225
3	.109	.....do.....	225
3 $\frac{1}{4}$	.120	.....do.....	225
3 $\frac{1}{2}$	.120	.....do.....	225
3 $\frac{3}{4}$	.120	.....do.....	225
4	.134	.....do.....	225
4 $\frac{1}{4}$	.134	.....do.....	225
5	.148	.....do.....	225
6	.165	.....do.....	225

The manufacturers of tubes and steam pipe shall furnish with each shipment of tubes and steam pipe an affidavit certifying that such tubes and steam pipe are made in accordance with section 13 of Rule II of the Rules and Regulations of the Board of Supervising Inspectors. Copy of such affidavit shall be furnished to the local inspectors on application.

MAIN STEAM PIPE.

The thickness of, and steam pressure allowable on, all main steam pipe of wrought iron or steel shall be determined by the following formulas:

$$T = \frac{P \times D}{10,000} + .125$$

$$P = \frac{(T - .125) \times 10,000}{D}$$

Where P=pressure of steam allowable in pounds.

T=thickness of pipe.

D=diameter of pipe.

LAP-WELDED BOILER TUBES UP TO AND INCLUDING 4 INCHES IN DIAMETER.

All lap-welded tubes to be made of charcoal iron, or mild steel, made by any process.

SURFACE INSPECTION.

Tubes to be free from defective welds, cracks, blisters, scale pits, and sand marks.

TESTS.

The following tests to be made before shipment by the manufacturer:

(a) A test piece 2 inches in length cut from a tube must stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws, with bend at one side being in the weld.

(b) A second tube to have a flange turned over at right angles to the body of the tube and to have a width equal to three-eighths of an inch.

All the work to be done cold.

Each tube shall be subjected to an internal hydrostatic pressure of 500 pounds per square inch without showing signs of weakness or defects.

All steel tubes to have ends properly annealed by the manufacturer before shipment, and must stand expanding, flanging over on the tube plate and beading without flaw, crack, or opening at weld.

LAP-WELDED BOILER TUBES OVER $\frac{1}{4}$ INCHES UP TO AND INCLUDING 30 INCHES IN DIAMETER.

All lap-welded boiler tubes over 4 inches in diameter, up to and including 30 inches in diameter, to be made of wrought iron, or mild steel, made by any process.

(a) A test piece, 2 inches in length, cut from a tube, must stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws, with bend at one side in the weld.

Each tube shall be subjected to an internal hydrostatic pressure of 500 pounds per square inch without showing signs of weakness or defects.

All steel tubes to have ends properly annealed by the manufacturer before shipment. Tubes must stand drilling, riveting, and calking, and work necessary to install them into the tube head without showing any signs of weakness or defects.

No tube increased in thickness by welding one tube inside of another shall be allowed for use.

SEAMLESS STEEL BOILER TUBES.

MATERIAL.

The steel shall be made by the open-hearth process.

Tubes must be free from all surface defects. The defects to be particularly avoided in seamless tubes are tears, snakes, checks, slivers, scratches, laps, pits, rings, and sinks.

All seamless steel cold-drawn tubes shall be annealed as a final process. One or more tubes shall be selected at random from each charge of annealing furnace, and coupons cut from same for testing.

(a) A piece 3 inches long cut from the first tube must stand being flattened by hammering until the sides are brought parallel with a curve on the inside at the ends not greater than three times the thickness of the metal, without showing cracks or flaws.

(b) A flange shall be turned all around the end of the tube to a width equal to three-eighths of an inch beyond the outside body of the tube.

Tests (a) and (b) to be done cold.

Where hot-finished tubes are furnished, the tubes shall pass the same manipulating tests as cold-drawn tubes, and shall be subject to the same conditions as to gauge, but do not have to be annealed.

Each tube shall be subject to an internal hydrostatic pressure of 1,000 pounds per square inch, without showing signs of weakness or defects.

All tubes must stand expanding, flanging over on the tube plate, and beading without flaw or crack.

All individual tubes must be carefully gauged with a Birmingham wire gauge, and must come within the limits of one gauge under or one gauge over the specified thickness.

WELDED STEAM AND WATER PIPES.

From one-eighth of an inch inside diameter up to and including 30 inches inside diameter.

The pipe to be made of wrought iron or mild steel, smooth, straight, and free from defects.

Threaded pipe of standard thickness should be avoided as far as possible. In steam pipes it is a very serious matter and should not be allowed in any case on standard pipe over 5 inches diameter.

TESTS.

The following tests to be made before shipment by the manufacturer:

One-eighth inch inside diameter up to and including $3\frac{1}{4}$ inches inside diameter to be tested before shipment to 600 pounds per square inch hydrostatic pressure and not subject to any other test.

Four inches inside diameter up to and including 12 inches inside diameter.

(II, 13) Thirteen inches outside diameter up to and including 30 inches outside diameter.

(a) A test piece 2 inches in length cut from a pipe must stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws, with bend at one side being in the weld.

(b) Pulling tests must be made from every 50 pieces furnished, or fraction thereof, and must show the following results:

For steel.—Tensile strength not less than 50,000 pounds per square inch. Elongation in 8-inch specimen, not less than 20 per cent.

For iron.—Tensile strength not less than 44,000 pounds per square inch. Elongation in 8-inch specimen, not less than 12 per cent.

All pipe from 4-inch diameter up to and including 30-inch diameter to be tested before shipment to not less than 500 pounds per square inch hydrostatic pressure.

SEAMLESS STEEL STEAM AND WATER PIPES.

MATERIAL.

The steel shall be made by the open-hearth process.

SURFACE INSPECTION.

Pipe must be free, inside and outside, from all surface defects that would materially weaken it or form starting points of corrosion. The defects to be especially avoided are snakes, checks, slivers, laps, pits, etc. Pipe must be smooth and straight.

TESTS.

The following tests to be made before shipment by the manufacturer:

(a) A test piece, 2 inches in length, cut from a tube, must stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws.

(b) Pulling tests must be made from every 50 pieces furnished, or fraction thereof, and must show the following results:

Tensile strength, not less than 48,000 pounds per square inch.

Elongation in 8-inch specimen, not less than 12 per cent.

The results of the pulling tests must be forwarded by the manufacturer to the purchaser of steam pipe, who will forward same to the local inspector.

Any pipe used for mud or steam drums must have the ends of same properly annealed before the holes are drilled

or the heads are riveted in: *Provided*, That this paragraph shall apply only to drums not exceeding 15 inches in diameter for use on pipe and coil boilers. (II, 13)

When pipe is used for steam lines where flanges are riveted on and caulked, the ends of the pipe should be properly annealed before drilling or riveting the flanges on.

When pipes are expanded into flanges by proper and approved machinery, and flared out at the ends to an angle not exceeding 20° (said angle to be taken in the direction of the length of the pipe) and having a depth of flare equal to *at least* one and one-half times the thickness of the material in said pipe, such pipes may be used for all steam and exhaust pipes when tested to two and one-half times the working pressure and found perfect in every respect.

If the pipe is used for steam lines where the pipe is peened in and flanged over, the ends of the pipe should be properly annealed before the peening or flanging is done.

The use of a square-nosed tool is recommended for cutting tubes and pipe.

Provided, That this entire section 13 shall apply only to tubes and piping used or to be used in boilers whose construction was commenced after June 30, 1905.

TUBE PLATE.

14. The compressive stress for tube plates in boilers built after June 30, 1905, shall not be greater than found by the following formula: § 4418, R. S.

$$P = \frac{(D-d) T \times C}{W \times D}$$

Where P=working pressure.

D=least horizontal distance between tube centers in inches.

d=inside diameter of tube in inches.

T=thickness of tube plate in inches.

W=extreme width of combustion box in inches.

C=28,000.

EXAMPLE.

Required the working pressure of a tube sheet supporting a crown sheet braced by crown bars. Horizontal distance between tube centers, 4 inches; inside diameter of tube, $2\frac{3}{4}$ inches; thickness of tube sheets, $\frac{1}{2}$ inch; extreme width of combustion box, 20 inches; material, steel. Substituting values, we have

$$P = \frac{(4 - 2\frac{3}{4}) \times .5 \times 28,000}{20 \times 4} = 218.75 \text{ pounds.}$$

[illegible]

(II)

FLUES.

§ 4418, R. S.

15. The preceding table shall include all such riveted and lap-welded flues exceeding 6 inches in diameter and not exceeding 40 inches in diameter not otherwise provided for by law.

For any such flue requiring more pressure than is given in table, the same will be determined by proportion of thickness to any given pressure in table to thickness for pressure required, as per example:

A flue not over 19 inches in diameter and 3 feet long requires a thickness of .39 of an inch for 176 pounds pressure; what thickness would be required for 250 pounds pressure?

$$176 : 250 :: .39 : .5539,$$

or a thickness of .554 inch.

Or, if .39 inch thickness gives a pressure of 176 pounds, what will .554 inch thickness give?

$$.39 : .554 :: 176 : 250 \text{ pounds required.}$$

And all such flues shall be made in sections, according to their respective diameters, not to exceed the lengths prescribed in the table, and such sections shall be properly fitted one into the other and substantially riveted, and the thickness of material required for any such flue of a given diameter shall in no case be less than the least thickness prescribed in the table for any such given diameter; and all such flues may be allowed the prescribed working steam pressure if, in the opinion of the inspectors, it is deemed safe to make such allowance. Inspectors are therefore required, from actual measurement of each flue, to make such reduction from the prescribed working steam pressure for any material deviation in the uniformity of the thickness of material, or for any material deviation in the form of the flue from that of a true circle, as in their judgment the safety of navigation may require.

FURNACES.

§ 4418, R. S.

16. The tensile strength of steel used in constructing furnaces shall not exceed 67,000, and be not less than 58,000 pounds. The minimum elongation in 8 inches shall be 20 per cent.

All corrugated furnaces having plain parts at the ends not exceeding 9 inches in length (except flues especially provided for), when new, and made to practically true circles, shall be allowed a steam pressure in accordance with the following formula:

$$P = \frac{C \times T}{D}$$

$$P = \frac{C \times T}{D}$$

Where P=pressure in pounds.

T=thickness in inches, not less than five-sixteenths of an inch.

D=mean diameter in inches.

C=15,600, a constant, determined from an actual destructive test under the supervision of the Board of Supervising Inspectors, when corrugations are not more than 8 inches from center to center, and the radius of the outer corrugations is not more than one-half of the suspension curve.

[In calculating the mean diameter of the Morison furnace, the least inside diameter plus 2 inches may be taken as the mean diameter, thus—

Mean diameter=least inside diameter+2 inches.]

FOX TYPE.

$$P = \frac{C \times T}{D}$$

Where P=pressure in pounds.

T=thickness in inches, not less than five-sixteenths.

D=mean diameter in inches.

C=14,000, a constant, when corrugations are not more than 8 inches from center to center and not less than $1\frac{1}{2}$ inches deep.

PURVES TYPE

$$P = \frac{C \times T}{D}$$

Where P=pressure in pounds.

T=thickness in inches not less than seven-sixteenths.

D=least outside diameter in inches.

C=14,000, a constant, when rib projections are not more than 9 inches from center to center and not less than $1\frac{3}{8}$ inches deep.

BROWN TYPE.

$$P = \frac{C \times T}{D}$$

Where P=pressure in pounds

T=thickness in inches, not less than five-sixteenths.

- (II, 16) Where D =least outside diameter in inches.
 $C=14,000$, a constant (ascertained by an actual destruction test under the supervision of this Board), when corrugations are not more than 9 inches from center to center and not less than $1\frac{1}{2}$ inches deep.

The thickness of corrugated and ribbed furnaces shall be ascertained by actual measurement. The manufacturer shall have said furnace drilled for a one-fourth inch pipe tap and fitted with a screw plug that can be removed by the inspector when taking this measurement. For the Brown and Purves furnaces the holes shall be in the center of the second flat; for the Morison, Fox, and other similar types in the center of the top corrugation, at least as far in as the fourth corrugation from the end of the furnace.

TYPE HAVING SECTIONS 18 INCHES LONG.

$$P = \frac{C \times T}{D}$$

- Where P =pressure in pounds.
 T =thickness in inches, not less than seven-sixteenths.
 D =mean diameter in inches.
 $C=10,000$, a constant, when corrugated by sections not more than 18 inches from center to center and not less than $2\frac{1}{2}$ inches deep, measuring from the least inside to the greatest outside diameter of the corrugations, and having the ends fitted one into the other and substantially riveted together, provided that the plain parts at the ends do not exceed 12 inches in length.

ADAMSON TYPE.

When plain horizontal flues are made in sections of not more than 4 feet 6 inches and not less than 23 inches in length, and not less than five-sixteenths of an inch thick, and flanged to a depth of not less than three times the diameter of rivet hole plus the radius at furnace wall (inside diameter of furnace), the thickness of the flanges to be as near the thickness of the body of the plate as practicable.

The radii of the flanges on the fire side should be not less than three times the thickness of plate.

The distance from the edge of the rivet hole to the edge of the flange shall be not less than the diameter of the rivet hole, and the diameter of the rivets before driven shall be at least one-fourth inch larger than the thickness of the plate.

The depth of the ring between the flanges shall be not less than three times the diameter of the rivet hole, and

the ring shall be substantially riveted to the flanges. The fire edge of the ring shall terminate at or about the point of tangency to the curve of the flange, and the thickness of the ring shall be not less than one-half inch. (II, 16)

The pressure allowed shall be determined by the following formula:

PLAIN CIRCULAR FURNACES OR FLUES, AND ADAMSON FURNACES MADE IN SECTIONS NOT LESS THAN 23 INCHES IN LENGTH.

$$P = \frac{51.5}{D} [18.75 T - (L \times 1.03)]$$

Where P=working pressure in pounds per square inch.
D=outside diameter of furnace in inches.
L=length of furnace in inches.
T=thickness of plate in sixteenths of an inch.

EXAMPLE.

Given a furnace 44 inches in diameter, 48 inches in length, and one-half of an inch thick. Substituting values in formula, we have

$$P = \frac{51.5}{44} [18.75 \times 8 - (48 \times 1.03)] =$$

$$1.17 [150 - 49.4] = 117.7 \text{ pounds.}$$

VERTICAL TYPE.

Cylindrical flues used as furnaces in vertical boilers, when new, and made to practically true circles, shall be allowed a steam pressure by the following formula:

$$P = \frac{C \times T}{D}$$

Where P=pressure of steam allowable in pounds.
T=thickness of flue in inches, not less than one-fourth.
D=outside diameter of flue in inches, not to exceed 42 inches.
C=10,577, a constant, when the length of the flue does not exceed 42 inches, measuring from the center of the rivet holes in the head to the center of the rivet holes in the leg.

When the flue exceeds 42 inches in diameter, it is deemed to be flat surface and must be stayed accordingly.

CONE TOPS.

Flues used in vertical boilers as upper combustion chambers formed in the shape of a cone, when new and made to

- (II, 16) practically true circles, shall be allowed a steam pressure according to the following formula:

$$P = \frac{C \times T}{D}$$

Where P=pressure of steam allowable in pounds.

T=thickness of flue in inches, not less than five-sixteenths.

D=outside diameter in inches, at the center of the length of the flue, not to exceed 42 inches.

C=10,153, a constant, when the length of the flue does not exceed 42 inches, measuring from center of rivet holes in top of head to the center of rivet holes in the tube head.

When the flue exceeds 42 inches in diameter at the center, it shall be deemed flat surface and must be stayed accordingly.

STEAM-CHIMNEY FLUES.

§ 4418, R. S.

17. The Morison, Fox, Purves, or Brown types of corrugated furnaces may be used as flues for steam chimneys or superheaters and shall be allowed a steam pressure by their respective formulas, and other flues, as described below, when new and made to practically true circles, shall be allowed a steam pressure by the following formula:

$$P = \frac{C \times T}{D}$$

Where P=pressure in pounds.

T=thickness of material in inches.

D=outside diameter of flue in inches.

C=12,000 for flues under 30 inches in diameter, plates at least five-sixteenths of an inch thick, supported by angle rings at least 2½ by 2½ inches.

C=12,000 for flues 30 inches and under 45 inches in diameter, plates at least three-eighths of an inch thick, supported by angle rings at least 2½ by 2½ inches.

C=12,000 for flues 45 inches and under 55 inches in diameter, plates at least seven-sixteenths of an inch thick, supported by angle rings at least 3 by 3 inches.

C=12,000 for flues 55 inches and under 65 inches in diameter, plates at least one-half inch thick, supported by angle rings at least 3 by 3 inches.

Where $C=12,000$ for flues 65 inches and under 75 inches (II, 17)

in diameter, plates at least nine-sixteenths of an inch thick, supported by angle rings at least $3\frac{1}{2}$ by $3\frac{1}{2}$ inches.

$C=12,000$ for flues 75 inches and under 85 inches in diameter, plates at least five-eighths of an inch thick, supported by angle rings at least $3\frac{1}{2}$ by $3\frac{1}{2}$ inches.

$C=12,000$ for flues 85 inches in diameter, plates at least eleven-sixteenths of an inch thick, supported by angle rings at least 4 by 4 inches.

For flues over 85 inches in diameter, add one-sixteenth of an inch to eleven-sixteenths of an inch for every 10 inches increase in the diameter of the flue.

The distance, center to center, between angle rings, or center of angle rings to center of rivets in the heads, shall in no case exceed $2\frac{1}{2}$ feet.

The angle rings shall be accurately fitted and substantially riveted to the flue and connected to the outer shell by braces, which braces shall not exceed 20 inches from center to center on the flue.

EXAMPLE.

Required the working pressure of a flue, supported by angle rings, when used in a steam chimney, 55 inches in diameter and one-half of an inch thick. Substituting values, we have

$$P = \frac{12,000 \times .5}{55} = 109 \text{ pounds.}$$

ADAMSON RINGS.

Adamson rings may be substituted for the angle rings, but each ring shall not be at a greater distance than $2\frac{1}{2}$ feet from center to center of rings, which rings shall not be required to be braced to the outer shell.

EXAMPLE.

Required the working pressure of an Adamson flue used in a steam chimney 45 inches in diameter and one-half of an inch thick. Substituting values, we have

$$P = \frac{12,000 \times .5}{45} = 133 \text{ pounds.}$$

PLAIN FLUES.

$$P = \frac{C \times T}{D}$$

- (II, 17) Where P =pressure in pounds.
 T =thickness of material in inches.
 D =outside diameter of flue in inches.
 $C=8,000$ for flues under 32 inches in diameter,
 plates at least five-eighths of an inch thick,
 and not exceeding 8 feet in length.
 $C=8,000$ for flues over 32 inches and under 46
 inches in diameter, plates at least eleven-
 sixteenths of an inch thick, and not exceed-
 ing 8 feet in length.

EXAMPLE.

Required the working pressure of a plain flue used in a steam chimney 8 feet long, 46 inches in diameter, and eleven-sixteenths of an inch thick. Substituting values, we have

$$P = \frac{8,000 \times \frac{11}{16}}{46} = 119 \text{ pounds.}$$

SOCKET BOLTS.

- § 4418, R. S. 18. For all boilers carrying a steam pressure of 60 pounds and under per square inch the flue may be braced with socket bolts in lieu of angle rings, such bolts to have heads and the ends to be threaded for nuts, with plate washers not over 12 inches between centers (or equivalent) on the inside of the flue; bolts to be at least 1 inch in diameter at bottom of thread.

For all boilers carrying a steam pressure of over 60 pounds and not over 120 pounds per square inch the flue may be braced with socket bolts in lieu of angle rings, such bolts to have heads and the ends to be threaded for nuts, with plate washers not over 10 inches between centers (or equivalent) on the inside of flue; bolts to be at least $1\frac{1}{8}$ inches in diameter at bottom of thread.

PIPES.

COPPER.

- § 4418, R. S. 19. All copper pipe subject to pressure shall be flanged over or outward to a depth of not less than twice the thickness of the material in the pipe, and such flanging shall be made to a radius not to exceed the thickness of the pipe. On boilers whose construction was commenced after June 30, 1905, no bend will be allowed in copper pipe of which the radius is less than one and one-half times the diameter of the pipe, and such pipe must be so led and flanges so placed that they may be readily taken down if required. Such pipes must be protected by iron casings when run through coal bunkers, and must be clear of the coal chutes. The

thickness of material, according to the working pressure, (II, 19)
shall be determined by the following formula:

$$T = \frac{P \times D}{C} + c$$

Where T=thickness in inches.

P=working pressure.

D=inside diameter of pipe in inches.

C=8,000, a constant.

c=.0625.

EXAMPLE.

Required the thickness of material of a 5-inch copper pipe for a working pressure of 175 pounds per square inch. Substituting values, we have

$$T = \frac{175 \times 5}{8,000} + .0625 = .171 \text{ inch.}$$

The flanges of all copper steam pipes over 3 inches in diameter shall be made of brass or bronze composition, forged iron or steel, or open-hearth steel castings, and shall be securely brazed or riveted to the pipe: *Provided, however,* That when such pipes are properly formed with a taper through the flange, such taper being fully reinforced, the riveting or brazing may be dispensed with: *And provided also,* That when the pipe has been expanded by proper and capable machinery into grooved flanges and the pipe flared out at the ends to an angle of approximately 20°, said angle to be taken in the direction of the length of the pipe, and having a depth of flare equal to at least one and one-half times the thickness of the material in the pipe, said riveting or brazing may be dispensed with. Where copper pipes are expanded into or riveted to flanges it will be necessary for the pipes with their flanges attached to withstand a hydrostatic pressure of two and one-half times the boiler pressure.

Flanges must be of sufficient thickness, and must be fitted with such number of good and substantial bolts to make the joints at least equal in strength to all other parts of the pipe.

Any form of joint that will add to the safety or increase the strength of flange and pipe connections over those provided for by this rule will be allowed on any and all classes of steam pipe.

STEEL FEED AND STEAM PIPE.

The terminal and intermediate joints of all wrought-iron and homogeneous-steel feed and steam pipes over 2 inches in diameter, other than on pipe or coil boilers or steam generators, shall be made of wrought iron, homogeneous

(II, 19) steel, or flanges of equivalent material; and all such flanges shall have a depth through the bore of not less than that equal to one-half of the diameter of the pipe to which any such flange may be attached, and such bores shall increase slightly toward the face of the flanges, and the ends of such pipes shall be enlarged to fit the bore of the flanges, and they shall be substantially beaded over or outward into a recess in the face of each flange. Flanges welded to wrought iron, Bessemer, or other steel pipes may be used: *Provided*, That on boilers constructed prior to June 30, 1905, the foregoing provisions of this paragraph shall apply only to such pipes when over 3 inches in diameter.

But where such pipes are made of extra heavy lap-welded steam pipe up to and including 5 inches in diameter the flanges may be attached with screw threads, and all joints in bends may be made with good and substantial malleable-iron elbows or equivalent material.

All feed and steam pipes not over 2 inches in diameter may be attached at their terminal and intermediate joints with screw threads by flanges, sleeves, elbows, or union couplings, but where the ends of such pipes at their terminal joints are screwed into material in the boiler, drum, or other connection having a thickness of not less than one-half inch, the flanges at such terminal joints may be dispensed with. Where any such pipes are not over 1 inch in diameter, and any of the terminal ends are to be attached to material in the boiler or connection having a thickness of less than one-half inch, a nipple shall be firmly screwed into the boiler or connection against a shoulder, and a valve shall be screwed firmly to such nipple; and should inspectors deem it necessary for safety, they may require a jam nut to be screwed onto the inner end of any such nipple.

The word "terminal" shall be interpreted to mean the points where steam or feed pipes are attached to such appliances of boilers, generators, or engines as are placed on such to receive them.

All lap-welded iron or steel steam pipes over $5\frac{1}{2}$ inches in diameter or riveted wrought iron or steel or seamless drawn-steel steam pipes over $5\frac{1}{2}$ inches in diameter, in addition to being expanded into tapered holes and substantially beaded into recess in face of flanges, or when flared to an angle of approximately 20 degrees, shall be substantially and firmly riveted with good and substantial rivets through the hubs of such flanges; and no such hubs shall project from such flanges less than 2 inches in any case: *Provided, however*, That when such pipes are double riveted into cast-steel, wrought-iron, or homogeneous-steel flanges, said flanges to be equal in strength to the strength of the pipe, the process of expanding and beading may be dispensed with: *It is further provided*, That for pressures of 100 pounds and under, said pipes may be single riveted to the flanges in lieu of double riveting.

The joints of all flanges shall be made with a sufficient

number of good and substantial bolts or rivets to make such joints at least equal in strength to all other parts of the pipe. (II, 19)

Lap-welded steam pipes of iron or steel, with their flanges welded on, shall be tested by a hydrostatic pressure of at least double the working pressure of the steam to be carried, and properly annealed after all the work requiring fire is finished. When an affidavit of the manufacturer is furnished that such test has been made and pipes so annealed, they may be used for marine purposes.

When holes exceeding 6 inches in diameter are cut in boilers for pipe connections, man and hand hole plates, such holes shall be reinforced, either on the inside or outside of boiler, with reinforcing plates, which shall be securely riveted or properly fastened to the boiler, such reinforcing material to be rings of the same kind and quality as the material reinforced, and of sufficient width and thickness of material to equal the amount of material cut from such boilers, in flat surfaces; and where such opening is made in the circumferential plates of such boilers, the reinforcing ring shall have an area of at least one-half the area of material there would be in a line drawn across such opening parallel with the longitudinal seams of such portion of the boiler. On boilers carrying 75 pounds or less steam pressure a cast-iron stop valve, properly flanged, may be used as a reinforcement to such opening. When holes are cut in any flat surface of such boilers and such holes are flanged inwardly to a depth of not less than $1\frac{1}{2}$ inches, measuring from the outer surface, the reinforcement rings may be dispensed with.

No connection between shell of boiler and mud drum shall exceed 9 inches in diameter, and the flange of the mud-drum leg shall consist of an equal amount of material to that cut out of the shell of boiler.

Also plates constructed of plate steel of corrugated form, without opening in plate for bolt, corrugation forming support for bolt, will be allowed for use of manhole and hand-hole openings.

SLIP JOINTS.

All slip joints made after June 30, 1905, for use in steam pipes shall have their working parts made of copper or composition, and said pipes shall be of sufficient length and so adjusted as to prevent pipes from withdrawing from the stuffing box. Safety collars and nonadjustable stop bolts may be allowed in connection with such joints.

CAST STEEL AND CAST IRON.

20. No cast iron subject to pressure shall be allowed to be used in boilers or the pipes connected thereto, except as described as follows: § 4418, R. S.

Cast iron may be used in the construction of manhole and hand-hole plates, valves and cocks, water columns,

- (II, 20) flanges, saddles, ells, tees, crosses, or manifolds when such flanges, saddles, ells, tees, crosses, valves and cocks, or manifolds are bolted or riveted directly to the boiler and the valves or cocks; also casings of slip joints in pipes: *Provided, however,* That the material shall be of the best grade and of suitable thickness and uniform section for the pressure allowed on boilers.

Flowed steel castings shall possess a tensile strength of not less than 62,000 pounds, an elastic limit of not less than 30,000 pounds, to the square inch, reduction of area of not less than 35 per cent, elongation of not less than 25 per cent, and contain not more than .04 per cent of phosphorus, and not more than .03 per cent of sulphur. Each of such castings shall be distinctly marked with name of manufacturer. Manufacturer shall furnish report of tests to supervising inspector of district where castings are to be used. All steel castings shall be thoroughly annealed. Castings of steel possessing the foregoing characteristics may be used for the necks or nozzles connecting the steam drum, or dome, and the boiler, and for the fittings of boilers, and fittings of steam, feed, and water pipes: *Provided,* That nozzles made of cast steel shall not be used in connecting shells of externally-fired boilers to mud drums, when said nozzles are exposed to the direct action of the flame.

FEED WATER.

- § 4418, R. S. 21. The feed water shall not be admitted into any boiler at a temperature less than 100° F., and no marine boiler shall be used without having proper auxiliary appliances for supplying said boilers with water in addition to the usual mode employed.

NAME PLATES.

- § 4418, R. S. 22. There shall be fastened to each boiler a plate containing the name of the manufacturer of the material, the place where manufactured, the tensile strength, the name of the builder of the boiler, when and where built.

FUSIBLE PLUGS.

- § 4418, R. S. 23. Every boiler, other than boilers of the water-tube type, shall have at least one fusible plug as described below. Plugs shall be made of a bronze casing filled with good banca tin from end to end. The manufacturers of fusible plugs shall stamp their name or initials thereon for identification, and shall file with the local inspectors a certificate, duly sworn to, that such plugs are filled with banca tin.

Fusible plugs, except as otherwise provided for, shall have an external diameter of not less than three-fourths of an inch pipe tap, and the banca tin shall be at least one-

half of an inch in diameter at the smallest end and shall have a larger diameter at the center or at the opposite end of the plug. (II, 23)

Fusible plugs, when used in the tubes of upright boilers, shall have an external diameter of not less than three-eighths of an inch pipe tap, and the banca tin shall be at least one-fourth of an inch in diameter at the smaller end and shall have a greater diameter at the opposite end of the plug: *Provided, however,* That all plugs used in boilers carrying a steam pressure exceeding 150 pounds to the square inch may be reduced at the smaller end of the banca tin to five-sixteenths of an inch in diameter.

Externally heated cylindrical boilers, with flues, shall have one plug inserted in one flue, and also one plug inserted in shell of each boiler, immediately below the fire line and not less than 4 feet from the front end: *Provided, however,* That when such flues are not more than 6 inches in diameter a fusible plug of not less diameter than three-eighths-inch pipe tap may be used in such flues.

Other shell boilers, except especially provided for, shall have one plug inserted in the crown sheet of the back connection.

Vertical tubular boilers shall have one plug inserted in one of the tubes at least 2 inches below the lowest gauge cock, but in boilers having a cone top the plug shall be inserted in the upper tube sheet.

All plugs shall be inserted so that the small end of the banca tin shall be exposed to the fire.

It shall be the duty of the inspector at each annual inspection to see that the plugs are in good condition.

GAUGE COCKS AND WATER GLASS.

24. All boilers shall be supplied with one reliable water gauge and three gauge cocks in each boiler: *Provided,* That when the gauge glass and gauge cocks are connected to the boilers by a water column, there must be an additional gauge cock inserted in the head or shell of boiler. The lower gauge cock in boilers more than 48 inches in diameter shall not be less than 4 inches from the top of the flues or tubes. In boilers less than 48 inches in diameter the lower gauge cock shall not be less than $2\frac{1}{2}$ inches above the top of the flues or tubes. A gauge glass shall be considered a reliable water gauge, and a float such as used on western river steamers shall be considered on such boilers as a reliable water gauge. § 4418, R. S.

In vertical boilers or boilers of the water-tube type the location of the lowest gauge cock shall be determined by the local inspectors.

STEAM GAUGES.

25. All steam gauges heretofore in use on steamers shall be admissible by the inspectors, and other steam gauges hereafter made of equal merit shall be allowed. § 4418, R. S.

- (II, 25) All boilers or sets of boilers shall have attached to them at least one gauge that will correctly indicate a pressure of steam equal to 80 per cent of the hydrostatic pressure applied by the inspectors.

SAFETY VALVES.

- § 4418, R. S. 26. The areas of all safety valves on boilers contracted for or the construction of which commenced on or after June 1, 1904, shall be determined in accordance with the following formula and table:

$$\text{Formula: } a = .2074 \times \frac{W}{P}.$$

Where a = area of safety valve, in square inches, per square foot of grate surface.

W = pounds of water evaporated per square foot of grate surface per hour.

P = absolute pressure per square inch = working gauge pressure + 15.

From which formula the areas required per square foot of grate surface in the following table are found by assuming the different values of W and P .

The figures (a) in table multiplied by square feet of grate surface give the area of safety valve or valves required.

When this calculation results in an odd size of safety valve, use next larger standard size.

EXAMPLES.

Boiler pressure = 75 pounds per square inch (gauge).

2 furnaces: Grate surface = 2 (No.) \times 5 feet 6 inches (long) \times 3 feet (wide) = 33 square feet.

Water evaporated per pound of coal = 8 pounds.

Coal burned per square foot grate surface per hour = $12\frac{1}{2}$ pounds.

Evaporation per square foot grate surface per hour = $8 \times 12\frac{1}{2}$ = 100 pounds.

Hence W = 100 and gauge pressure = 75 pounds.

From table the corresponding value of a is .230 square inches.

Therefore area of safety valve = $33 \times .23$ = 7.59 square inches.

For which the diameter is $3\frac{1}{8}$ inches nearly.

Boiler pressure = 215 pounds.

6 furnaces: Grate surface = 6 (No.) \times 5 feet 6 inches (long) \times 3 feet 4 inches (wide) = 110 square feet.

Water evaporated per pound coal = 10 pounds.

Coal burned per square foot grate surface per hour = 30 pounds.

Evaporation per square foot grate surface per hour = 10×30 = 300 pounds.

Hence $W=300$, gauge pressure $=215$, and $a=.270$ (from (II, 26) table).

Therefore area of safety valve $=110 \times .270 = 29.7$ square inches, which is too large for one valve. Use two. $\frac{29.7}{2} = 14.85$ square inches. Diameter $= 4\frac{3}{8}$ inches.

TABLE 1. AREA OF SAFETY VALVE REQUIRED PER SQUARE FOOT OF GRATE SURFACE FOR DIFFERENT PRESSURES AND RATES OF EVAPORATION—Continued.

P. absolute pressure per square inch.	Gauge pressure per square inch.	These figures represent evaporation in pounds per square foot of grate surface per hour (W) = pounds water evaporated per pound coal \times pounds coal burned per square foot of grate surface per hour.														
		100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
The figures below give <i>a</i> , the area in square inches required per square foot of grate surface at the above rate of evaporation.																
270	255	.077	.092	.107	.123	.138	.153	.169	.184	.199	.215	.230	.245	.261	.276	.291
275	260	.075	.090	.105	.121	.136	.151	.166	.181	.196	.211	.226	.241	.256	.271	.286
280	265	.074	.089	.104	.119	.133	.148	.163	.178	.192	.207	.222	.237	.251	.266	.281
285	270	.073	.087	.102	.116	.131	.146	.160	.175	.189	.204	.218	.233	.247	.262	.276
290	275	.072	.086	.100	.114	.129	.143	.157	.172	.186	.200	.214	.228	.242	.257	.271
295	280	.070	.084	.098	.112	.127	.141	.154	.169	.182	.196	.210	.224	.238	.253	.267
300	285	.069	.083	.096	.110	.124	.138	.151	.166	.179	.193	.207	.221	.235	.249	.263
305	290	.068	.082	.095	.109	.122	.136	.149	.163	.177	.190	.204	.217	.231	.245	.258
310	295	.067	.080	.093	.107	.120	.134	.147	.160	.174	.187	.201	.214	.227	.241	.254
315	300	.066	.079	.092	.105	.118	.132	.145	.158	.171	.184	.197	.210	.223	.237	.250

(II, 26) Any spring-loaded safety valve constructed so as to give an increased lift by the operation of steam, after being raised from its seat, or any spring-loaded safety valve constructed in any other manner so as to give an effective area equal to that of the aforementioned spring-loaded safety valve, may be used in lieu of the common lever-weighted valve on all boilers on steam vessels, and each spring-loaded valve shall be supplied with a lever that will raise the valve from its seat a distance of not less than that equal to one-eighth of the diameter of the valve opening; but in no case shall any spring-loaded safety valve be used in lieu of the lever-weighted safety valve without first having been approved by the Board of Supervising Inspectors.

The valves shall be so arranged that each boiler shall have at least one separate safety valve, unless the arrangement is such as to preclude the possibility of shutting off the communication of any boiler with the safety valve or valves employed. This arrangement shall also apply to lock-up safety valves when they are employed.

The use of two safety valves may be allowed on any boiler, provided the combined area of such valves is equal to that required by rule for one such valve. Whenever the area of a safety valve, as found by the rule of this section, will be greater than that corresponding to 6 inches in diameter, two or more safety valves, the combined area of which shall be equal at least to the area required, must be used.

The seats of all safety valves shall have an angle of inclination of 45 degrees to the center line of their axes.

The use of the lever safety valves shall be prohibited on all boilers built after June 30, 1906.

All common lever safety valves to be hereafter applied to the boilers of steam vessels must be constructed in material, workmanship, and principle according to the requirements for a safety valve referred to in this section.

When this construction of a safety valve is applied to the boilers of steamers navigating rough waters, the link may be connected direct with the spindle of the valve: *Provided always*, That the fulcrum or points upon which the lever rests are made of steel, knife or sharp edged, and hardened; in this case the short end of the lever should be attached directly to the valve casing. In all cases the link requires but a slight movement, not exceeding one-eighth of an inch.

REQUIREMENTS IN CONSTRUCTION OF LEVER-SAFETY VALVES.

All the points of bearing on lever must be in the same plane.

The distance of the fulcrum must in no case be less than the diameter of the valve opening.

The length of the lever should not exceed the distance of the fulcrum multiplied by ten.

The width of the bearings of the fulcrum must not be less than three-fourths of 1 inch.

The length of the fulcrum link should not be less than 4 inches. (II, 26)

The lever and fulcrum link must be made of wrought iron or steel, and the knife-edged fulcrum points and bearings for the points must be made of steel and hardened. But the chambers and saddle flanges of this and all other types of safety valves attached to boilers may be made of cast iron or other suitable material.

The valve, valve seat, and bushing for the stem or spindle must be made of composition (gun metal) when the valve is intended to be attached to a boiler using salt water; but when the valve is to be attached to a boiler using fresh water and generating steam of a high pressure the parts named, with the exception of the bushings for the spindle, may be made of cast iron. On safety valves constructed after June 30, 1905, neither the valve nor the valve seats shall be of cast iron.

The valve must be guided by its spindle, both above and below the ground seat and above the lever, through supports either made of composition (gun metal) or bushed with it.

The spindle should fit loosely in the bearings or supports.

When the valve is intended to be applied to the boilers of steamers navigating rough waters the fulcrum link may be connected directly with the spindle of the valve: *Providing, always*, That the knife-edged fulcrum points are made of steel and hardened, and that the vertical movement of the valve is unobstructed by any lateral movement.

In all cases the weight must be adjusted on the lever to the pressure of steam allowed in each case by a correct steam gauge attached to the boiler. The weight must then be securely fastened in its position and the lever marked for the purpose of facilitating the replacing of the weight should it be necessary to remove the same, and in no case shall a line or any other device be attached to the lever or weight except in such a manner as will enable the engineer to raise the valve from its seat.

SEA COCKS.

27. All sea valves or cocks secured to the skin of the vessel by bolts and connected to the engines or boilers by pipes shall be arranged so as to be accessible at all times, so that if a leak or defect occurs it can be reached. All parts of said valves except the chamber shall be made of brass or bronze when used on wooden-hull vessels navigating salt water; but in the case of iron-hull vessels the brass or bronze bolts may be dispensed with. § 4418, R. S.

STOP VALVES.

28. On all boilers built after July 1, 1896, a bronze or brass seated stopcock or valve shall be attached to the boiler between all check valves and all steam and feed § 4418, R. S.

- (II, 28) pipes and boilers, in order to facilitate access to connections. Where such cocks or valves exceed $1\frac{1}{2}$ inches in diameter they must be flanged to boiler. The stop valves attached to main steam pipes when bolted or riveted directly to boiler may, however, be made of cast iron or other suitable material.

WOODWORK FROM BOILERS.

§ 4418, R. S. 29. *Externally heated boilers* shall have a clear space between the boiler and the woodwork of not less than 6 inches at the sides and 4 inches at the top.

Internally heated boilers shall have a clear space between the boiler and the woodwork of not less than 4 inches at the sides and 4 inches at the top.

All woodwork or other ignitable substance approaching within 12 inches of the boiler or smokestack (unless such boiler or smokestack is covered with good nonconducting material) shall be suitably sheathed with metal over noncombustible material, and it shall be the duty of the inspectors to see that all woodwork or other ignitable substance in or around the fireroom is properly protected by metal or asbestos sheathing.

All boilers hereafter placed in wooden steamers shall have a clear space of at least 8 inches between the under side of the cylindrical shell and the floor or keelson; and on all other steamers the boilers shall be so placed as to permit of proper inspection of the under side thereof.

All boilers shall have a clear space at the back and ends thereof of 2 feet opposite the back-connection door: *Provided*, That on vessels constructed of iron or steel with metal bulkheads the distance between back-connection doors and such metal bulkheads shall not be less than 16 inches.

MANHOLES.

§ 4418, R. S. 30. All manholes for the shell of boilers over 40 inches in diameter, when practicable for use, shall have an opening not less than 10 by 16 or 11 by 15 inches in the clear, except that boilers 40 inches diameter of shell and under shall have an opening of not less than 9 by 15 inches in the clear in manholes: *Provided*, That manhole opening in front head of externally fired boilers, under the flues, as required by section 4434, Revised Statutes of the United States, shall be of dimensions not less than 8 by 12 inches in the clear.

WESTERN RIVER BOILERS.

HEADS.

§§ 4418, 4434, R. S. 31. All heads employed in the construction of cylindrical externally fired boilers for steamers navigating the Red River of the North and rivers whose waters flow into

the Gulf of Mexico shall have a thickness of material as follows: (II, 31)

For boilers having a diameter—

- Over 32 inches and not over 36 inches, not less than $\frac{1}{2}$ inch.
- Over 36 inches and not over 40 inches, not less than $\frac{3}{8}$ inch.
- Over 40 inches and not over 48 inches, not less than $\frac{1}{2}$ inch.
- Over 48 inches, not less than $\frac{3}{4}$ inch.

The heads of steam and mud drums of such boilers shall have a thickness of material of not less than half an inch; pressure to be determined by formula for flatheads.

MANHOLES.

The manhole opening, as required by section 4434, Revised Statutes of the United States, shall be of dimensions not less than 8 inches by 12 inches in the clear.

LOW-WATER GAUGE.

All horizontal cylindrical boilers used on steamers navigating the waters flowing into the Gulf of Mexico shall be provided with a reliable low-water gauge.

FLUES.

Local inspectors in determining the distance between the flues and the shells of externally fired boilers, under provisions of section 4434, Revised Statutes of the United States, shall take the measurements from the plate in the flue to the plate in the shell.

WATER TUBE AND COIL BOILERS.

32. Blue prints or drawings of coil boilers and of other boilers, with their specifications, submitted to the Board of Supervising Inspectors for approval under section 4429, Revised Statutes of the United States, must be in duplicate before action thereon will be taken by the Board, with a view of approving the same; one set to be filed with the records of the Board of Supervising Inspectors and the other with the records of the supervising inspector of the district where the manufacturer of the boiler is located. § 4429, R. S.

The working pressure allowable on cylindrical shells of water tube or coil boilers, when such shells have a row or rows of pipes or tubes inserted therein, shall be determined by the following formula:

$$P = \frac{(D-d) \times T \times S}{D \times R}$$

Where P = working pressure allowable in pounds.

D = distance in inches between the tube or pipe centers in a line from head to head.

d = diameter of hole in inches.

T = thickness of plate in inches.

S = one-sixth of the tensile strength of the plate.

R = radius of shell in inches.

(II, 32)

EXAMPLE.

Required the working pressure of a cylindrical shell having holes 1 inch in diameter, spaced 2 inches from center to center, in a line from head to head; material, one-half of an inch thick; diameter of shell, 20 inches; tensile strength of plate, 60,000 pounds.

Substituting values, we have

$$P = \frac{(2-1) \times .5 \times 10,000}{2 \times 10} = 250 \text{ pounds.}$$

PORCUPINE-TYPE BOILERS.

The formula for determining pressure on boilers of the so-called Porcupine and similar types shall be as follows:

Multiply the vertical distance between the centers of the horizontal rows of tubes in inches by one-half the diameter of shell of boiler in inches, which gives the area upon which the pressure is exerted to break a diagonal ligament, then find the sectional area of the ligament at its smallest part and multiply by one-sixth the tensile strength of the material. This result, divided by the area upon which the strain is exerted, gives the working pressure per square inch, which is as follows: $\frac{E F T}{C D} = W$, the

working pressure, in which E equals width of ligament in inches, F thickness of material in inches, T one-sixth the tensile strength, C distance between vertical centers, and D one-half the inside diameter of the shell or central column.

For the boiler proposed, 30 inches diameter, five-eighths inch thick, tensile strength 60,000 pounds, 1.219 inches would be width of ligament, .625 thickness of plate; 10,000 one-sixth of tensile strength, $3\frac{1}{4} = 3.6875$ inches, distance of vertical centers; 15 inches, one-half the diameter of shell, would be as follows: 1.219 multiplied by .625, this product multiplied by one-sixth the tensile strength, 10,000, equals 7,618.75. This product, divided by the product of 3.6875, distance between vertical centers, multiplied by 15, one-half the diameter, equals 55.3125, gives 137.7 as pressure allowed.

HYDROSTATIC PRESSURE.

All coil and pipe boilers hereafter made, when such boiler is completed and ready for inspection, must be subjected at the first inspection to a hydrostatic pressure double that of the steam pressure allowed in the certificate of inspection.

The use of malleable-iron or cast-steel manifolds, tees, return bends, or elbows in the construction of pipe generators shall be allowed, and the pressure of steam shall not be restricted to less than one-half the hydrostatic pressure applied to pipe generators unless a weakness should develop under such test as would render it unsafe in the judgment of the inspector making such inspection.

DRUMS AND HEADS.

(II, 32)

All drums attached to coil, pipe, sectional, or water-tube boilers not already in use or actually contracted for, to be built for use on a steam vessel, and its building commenced at or before the date of the approval of this rule, shall be required to have the heads of wrought iron or steel or cast steel flanged and substantially riveted to the drums, or secured by bolts and nuts of equal strength with rivets, in all cases where the diameters of such drums exceed 6 inches.

Drums and water cylinders constructed with a bumped head at each or either end, any opening in the shell or heads to be reinforced as required by the rules of the Board, the circumferential and horizontal seams to be welded and properly annealed after such welding is completed, and when tested with a hydrostatic pressure of at least double the amount of the steam pressure allowed may be used for marine purposes.

COPPER AND BRASS TUBES.

Seamless copper or brass tubes not exceeding three-fourths of an inch in diameter may be used in the construction of water-tube boilers or generators when liquid fuel is used. There may also be used in their construction copper or brass steam drums not exceeding 14 inches in diameter, of a thickness of material not less than five-eighths of an inch, and copper or brass steam drums 12 inches in diameter and under having a thickness of material of not less than one-half inch. All tubes and drums referred to in this paragraph shall be made from ingots or blanks drawn down to size without a seam. Water-tube boilers or generators so constructed may be used for marine purposes with none other than liquid fuel.

Table of pressures allowable on boilers made since February 28, 1872.

Diameter of boiler.	Thick-ness of plates.	45,000 tensile strength, 1-6, 7,500.		50,000 tensile strength, 1-6, 8,333.3.		55,000 tensile strength, 1-6, 9,166.6.		60,000 tensile strength, 1-6, 10,000.		65,000 tensile strength, 1-6, 10,833.3.		70,000 tensile strength, 1-6, 11,666.6.		Diameter of boiler.
		Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	
36 inches.	.1875	78.12	98.74	86.8	104.16	95.48	114.57	104.16	124.99	112.84	135.4	121.52	145.82	36 inches.
	.21	87.5	105	97.21	116.65	106.94	128.33	116.66	139.99	126.38	151.65	136.11	163.33	
	.23	95.83	114.99	106.47	127.76	117.12	140.54	127.77	153.82	138.41	166.09	149.07	178.88	
	.25	104.16	124.99	115.74	138.88	127.31	152.77	138.88	166.65	150.46	180.55	162.03	194.43	
	.26	108.33	129.99	120.37	144.44	132.4	158.88	144.44	173.82	156.48	187.77	168.51	202.21	
	.29	120.83	144.99	134.25	161.11	147.68	177.21	161.11	193.83	174.53	209.43	187.96	225.55	
	.3125	130.2	156.24	144.67	173.6	159.14	190.96	173.6	208.82	188.07	225.68	202.5	243.04	
	.33	137.5	165	152.77	183.32	168.05	201.66	183.33	219.99	198.61	238.76	213.88	256.65	
	.35	145.83	174.99	162.03	194.43	178.23	213.87	194.44	233.32	210.64	252.76	226.84	272.20	
	.375	156.25	187.5	173.61	208.33	190.97	229.16	208.33	249.99	225.69	270.83	243.05	291.66	
38 inches.	.1875	74.01	88.81	82.23	98.67	90.46	108.54	98.68	118.41	106.9	128.28	115.13	138.16	38 inches.
	.21	82.89	99.46	92.1	110.52	101.31	121.57	110.52	132.62	119.73	143.67	128.93	154.71	
	.23	90.78	108.98	100.87	121.04	110.96	133.15	121.05	145.26	131.13	157.35	141.22	169.46	
	.25	98.68	118.41	109.64	131.56	120.61	144.73	131.57	157.89	142.54	171.04	153.5	184.20	
	.26	102.63	123.15	114.03	136.83	125.43	150.51	136.84	164.2	148.24	177.88	159.64	191.56	
	.29	114.47	137.36	127.19	162.62	139.91	167.89	152.63	183.15	165.35	198.42	178.06	213.67	
	.3125	123.35	148.02	137.06	164.46	150.76	180.91	164.47	197.36	178.17	213.8	191.88	230.25	
	.33	130.26	156.31	144.73	173.67	159.2	191.04	173.68	206.41	188.15	225.78	202.62	243.14	
	.35	138.15	165.78	153.5	184.21	168.85	202.62	184.21	221.05	199.56	239.47	214.91	257.89	
	.375	148	177.60	164.73	197.67	180.91	217.09	197.36	236.83	213.81	256.57	230.26	276.31	
40 inches.	.1875	70.31	84.37	78.12	93.74	85.93	103.11	93.75	112.5	101.56	121.87	109.37	131.24	40 inches.
	.21	78.75	94.50	87.49	104.98	96.24	115.48	105	126	113.74	136.48	122.49	146.98	
	.23	86.25	103.5	95.83	114.99	105.41	126.49	115	138	124.58	149.49	134.16	160.99	
	.25	93.75	112.5	104.16	124.99	114.53	137.49	125	150	135.41	162.49	145.83	174.99	
	.26	97.5	117	108.33	129.99	119.16	142.99	130	156	140.83	168.99	151.66	181.99	
	.29	108.75	130.5	120.83	144.99	132.91	159.49	145	174	157.08	188.49	169.16	202.99	
	.3125	117.18	140.61	130.2	156.24	143.22	171.86	156.25	187.45	169.27	203.12	182.29	218.74	
	.33	122.75	148.5	137.49	164.98	151.24	181.48	165	198	178.74	214.48	192.49	230.98	

42 inches	.35	131.25	157.5	145.88	174.99	160.41	192.49	175	210	199.58	227.49	204.16	244.99
	.375	140.62	168.74	156.24	187.48	171.87	206.24	187.5	225	208.12	243.74	218.74	262.48
	.1375	66.96	80.85	74.40	89.28	81.84	98.20	89.28	107.13	96.72	116.06	104.16	124.99
	.21	75	90	83.82	99.99	91.66	109.99	100	120	108.33	129.99	116.66	139.99
	.23	82.14	98.56	91.23	109.51	100.39	120.46	109.52	131.42	118.65	142.38	127.77	153.82
	.25	89.26	107.13	99.2	119.04	109.12	130.94	119.04	142.84	128.96	154.75	138.88	166.65
	.26	92.85	111.42	103.17	123.8	113.49	136.18	123.8	148.56	134.12	160.94	144.44	173.82
	.29	103.57	124.28	115.07	138.08	126.57	151.85	138.09	165.7	149.6	179.52	161.11	198.83
	.3125	111.6	133.92	124	148.8	136.4	163.68	148.74	178.56	161.2	193.44	173.61	208.23
	.33	117.85	141.42	130.94	157.12	144.04	172.84	157.14	188.56	170.23	204.27	183.33	219.99
	.35	125	150	138.88	166.65	152.77	183.82	166.66	199.99	180.55	216.56	194.44	233.82
	.375	133.92	160.7	148.8	178.56	163.68	196.40	178.57	214.28	183.45	232.14	208.88	249.99
44 inches	.1375	68.92	76.7	71.02	85.22	78.12	93.74	85.22	102.26	92.82	110.78	99.42	119.3
	.21	71.59	85.9	79.54	96.44	87.49	104.98	96.45	114.54	103.4	124.08	111.36	133.63
	.23	78.4	94.08	87.12	104.54	95.83	114.99	104.54	125.44	113.25	135.9	121.96	146.85
	.25	85.22	102.26	94.69	113.62	104.16	124.99	113.63	136.35	123.1	147.72	132.56	159.07
	.26	88.63	106.35	98.48	118.17	108.83	129.99	118.18	141.81	128.02	153.62	137.87	165.44
	.29	98.56	118.63	109.84	131.80	120.83	144.99	131.81	153.17	142.79	171.33	153.78	184.58
	.3125	106.83	127.83	118.86	142.03	130.2	156.24	142.04	170.44	153.88	184.65	165.71	198.85
	.33	112.5	135	124.99	149.98	137.49	164.98	150	180	162.49	194.98	174.99	209.98
	.35	119.31	148.17	132.57	159.08	145.83	174.99	159.09	190.9	172.94	206.8	186.6	222.72
	.375	127.81	153.37	142.04	170.44	156.24	187.48	170.45	204.54	184.65	221.58	198.86	238.63
	.1375	61.14	73.36	67.93	81.51	74.72	89.66	81.51	97.81	88.31	105.97	95.1	114.12
	.21	68.47	82.16	76.08	91.29	83.69	100.42	91.3	109.56	99.91	118.69	106.52	127.82
46 inches	.23	75	90	83.83	100	91.66	109.99	100	120	108.33	129.99	116.66	139.99
	.25	81.52	97.82	90.57	108.68	99.63	119.55	108.69	130.42	117.75	141.3	126.8	152.16
	.26	84.78	101.73	94.2	113.04	108.62	124.84	113.44	135.64	122.46	146.95	131.88	158.25
	.29	94.56	113.47	105.07	126	115.57	138.68	126.09	151.3	136.59	163.92	147.1	176.52
	.3125	101.9	122.28	113.21	135.86	124.54	149.44	135.86	163.03	147.19	176.62	158.51	190.21
	.33	107.6	129.12	119.56	143.47	131.62	157.82	143.97	172.16	155.43	186.51	167.39	200.86
	.35	144.13	186.95	126.8	162.16	139.49	167.38	152.17	182.6	164.85	197.82	177.53	218.03
	.375	122.28	146.73	136.86	163.03	149.45	179.34	163.04	196.64	176.62	211.94	190.21	228.25
	.1375	58.59	70.30	65.1	78.12	71.61	85.98	78.12	93.74	84.63	101.65	91.13	109.35
	.21	65.62	78.74	72.91	87.49	80.2	96.24	87.49	104.98	94.79	113.74	102.08	122.49
48 inches	.1375	58.59	70.30	65.1	78.12	71.61	85.98	78.12	93.74	84.63	101.65	91.13	109.35
	.21	65.62	78.74	72.91	87.49	80.2	96.24	87.49	104.98	94.79	113.74	102.08	122.49

Table of pressures allowable on boilers made since February 28, 1879—Continued.

Diameter of boiler.	Thick-ness of plates.	45,000 tensile strength, 1-6, 7,500.		50,000 tensile strength, 1-6, 8,333.3.		55,000 tensile strength, 1-6, 9,166.6.		60,000 tensile strength, 1-6, 10,000.		65,000 tensile strength, 1-6, 10,833.3.		70,000 tensile strength, 1-6, 11,666.6.		Diameter of boiler.
		Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	
48 inches.	.28	71.87	86.24	79.85	95.82	87.84	105.4	95.83	114.99	103.81	124.57	111.8	133.16	48 inches.
	.25	78.12	93.74	86.8	104.16	95.48	114.57	104.16	124.99	112.84	135.4	121.52	145.82	
	.26	81.25	97.50	90.27	108.32	99.3	119.16	108.33	129.99	117.36	140.83	126.38	151.65	
	.29	90.62	108.74	100.69	120.82	110.76	132.91	120.83	144.99	130.9	157.08	140.97	169.16	
	.3125	97.65	117.18	108.5	130.2	119.35	143.22	130.21	156.25	141.05	169.26	151.9	182.28	
	.33	103.12	123.74	114.58	137.49	125.04	151.24	137.5	165	148.95	178.74	160.41	192.49	
	.35	109.37	131.24	121.52	145.83	133.67	160.4	145.83	174.99	157.98	189.57	170.13	204.15	
	.375	117.18	140.61	130.2	156.24	143.22	171.86	156.25	187.50	169.27	203.12	182.29	218.74	
	.1875	52.08	62.49	57.87	69.44	63.65	76.38	69.44	82.44	75.23	90.27	81.01	97.21	
	.21	58.33	69.99	64.81	77.77	71.29	85.54	77.77	93.82	84.25	101.1	90.74	108.88	
54 inches.	.23	63.88	76.65	70.98	85.17	78.08	93.69	85.18	102.21	92.28	110.73	99.38	119.25	54 inches.
	.25	69.44	83.32	77.16	92.59	84.87	101.84	92.59	111.10	100.3	120.36	108.02	129.62	
	.26	72.22	86.66	80.24	96.28	88.27	105.92	96.29	115.54	104.31	125.17	112.44	134.8	
	.29	80.55	96.66	89.5	107.40	96.45	118.14	107.41	123.83	116.35	139.62	125.3	150.36	
	.3125	86.8	104.16	96.44	115.73	106.09	127.90	115.55	138.66	125.38	150.45	135.03	162.03	
	.33	91.66	109.99	101.84	122.22	112.03	134.43	122.22	146.66	132.4	158.88	142.59	171.10	
	.35	97.22	116.66	108.02	129.62	118.82	142.58	129.62	155.54	140.43	168.51	151.23	181.47	
	.375	104.16	124.99	115.74	138.88	127.31	152.77	138.88	166.65	150.46	180.55	162.03	194.43	
	.1875	46.87	56.24	52.08	62.49	57.29	68.74	62.5	75	67.7	81.24	72.91	87.49	
	.21	52.5	63	58.33	69.99	64.16	76.99	69.99	84	75.83	90.99	81.66	97.99	
60 inches.	.23	57.5	69	63.88	76.65	70.27	84.32	76.66	91.99	83.05	99.66	88.44	107.32	60 inches.
	.25	62.5	75	69.44	83.32	76.38	91.65	83.33	99.99	91.65	108.32	97.22	116.66	
	.26	65	78	72.22	86.66	79.44	95.82	86.66	103.99	98.88	112.65	101.11	121.33	
	.29	72.5	87	80.55	96.66	88.61	106.33	96.66	115.99	104.72	125.66	112.77	135.32	
	.3125	79.12	93.74	86.8	104.16	95.48	114.57	104.16	124.99	112.84	135.4	121.52	145.82	

66 inches	.88	82.5	99	91.66	109.99	100.88	120.99	109.99	182	119.16	142.99	128.88	158.99
	.85	87.5	106	97.22	116.66	106.94	128.82	116.66	189.99	126.88	151.65	136.11	168.88
	.875	93.75	112.5	104.16	124.99	114.58	137.49	125	150	135.41	162.49	145.88	174.99
	.1875	42.61	51.13	47.84	56.8	52.07	62.49	56.81	68.17	61.55	73.86	66.28	79.53
	.21	47.72	57.26	58	68.63	58.33	69.99	63.63	76.35	66.98	82.71	74.24	89.08
	.23	52.27	62.72	58	69.69	63.58	76.65	69.69	83.62	75.5	90.6	81.31	97.57
	.25	56.81	68.17	63.13	75.75	69.44	83.82	75.75	90.90	82.07	98.48	88.88	106.06
	.26	59.09	70.9	65.65	78.78	72.22	86.66	78.78	94.53	85.35	102.42	91.91	110.29
	.29	65.90	78.08	73.23	87.87	80.55	96.66	87.87	105.44	95.2	114.24	102.52	123.02
	.3125	71	85.2	78.91	94.69	86.89	104.16	94.69	113.62	102.58	128.09	110.47	132.56
	.33	75	90	83.83	99.99	91.66	109.99	99.99	120	108.33	129.99	116.66	139.99
	.35	79.56	95.47	88.88	106.05	97.22	116.66	106	127.27	114.89	137.86	123.73	148.47
	.375	85.22	102.26	94.69	113.62	104.16	124.99	113.62	136.34	123.1	147.72	132.57	159.08
72 inches	.1875	39.06	46.87	43.4	52.08	47.74	57.28	52.08	62.49	56.42	67.70	60.76	72.91
	.21	43.75	52.5	48.6	58.33	53.47	64.16	58.33	69.99	63.19	75.82	68.05	81.66
	.23	47.91	57.49	53.24	63.88	58.56	70.27	63.88	76.65	69.21	83.05	74.53	89.43
	.25	52.08	62.49	57.87	69.44	63.65	76.38	69.44	83.32	75.22	90.26	81.01	97.21
	.26	54.16	64.99	60.18	72.21	66.2	78.44	72.22	86.66	78.24	93.88	84.25	101.10
	.29	60.41	72.49	67.12	80.54	73.84	88.60	80.55	96.66	87.26	104.71	93.98	112.77
	.3125	65.10	78.12	72.33	86.8	79.57	95.48	86.8	104.16	94.03	112.53	101.27	121.52
	.33	68.75	82.5	76.38	91.65	84.02	100.82	91.66	109.99	99.3	119.16	106.94	128.82
	.35	72.91	87.49	81.01	97.21	89.11	106.93	97.22	116.66	105.32	126.38	113.42	136.1
	.375	78.12	93.74	86.8	104.16	95.48	114.57	104.16	124.99	112.84	135.48	121.52	145.82
	.1875	36.05	43.21	40.06	48.07	44.07	52.87	48.07	57.68	52.08	62.49	56.08	67.29
	.21	40.38	48.45	44.87	53.84	49.35	59.22	53.84	64.60	58.33	69.99	62.82	75.38
	.23	44.23	53.07	49.14	58.96	54.05	64.86	58.96	70.76	63.88	76.65	68.80	82.56
78 inches	.25	48.07	57.68	53.41	64.09	58.76	70.5	64.4	76.92	69.44	83.32	74.78	89.73
	.26	50	60	55.55	66.66	66.11	73.33	66.66	79.99	72.22	86.66	77.77	93.82
	.29	55.76	66.91	61.96	74.35	68.16	81.79	74.35	89.22	80.55	96.66	86.75	104.1
	.3125	60.09	72.1	66.77	80.12	73.45	88.14	80.12	96.14	86.8	104.16	98.48	112.17
	.33	63.46	76.15	70.51	84.61	77.56	93.07	84.61	101.53	91.66	109.94	98.71	118.45
	.35	67.3	80.76	74.78	89.73	82.26	98.71	89.74	107.68	97.22	116.66	104.70	125.64
	.375	72.11	86.53	80.12	96.14	88.14	105.76	96.15	115.88	104.16	124.99	112.17	134.6

Table of pressures allowable on boilers made since February 28, 1872—Continued.

Diameter of boiler.	Thickness of plates.	45,000 tensile strength, 1-6, 7,500.		50,000 tensile strength, 1-6, 8,833.3.		55,000 tensile strength, 1-6, 9,166.6.		60,000 tensile strength, 1-6, 10,000.		65,000 tensile strength, 1-6, 10,833.3.		70,000 tensile strength, 1-6, 11,666.6.		Diameter of boiler.
		Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	Pressure.	20 per cent additional.	
84 inches ..	.1875	33.48	40.17	37.2	44.68	40.92	49.1	44.64	53.56	48.36	58.03	52.08	62.49	84 inches
	.21	37.5	45	41.66	49.99	45.83	54.99	50	60	54.16	64.99	58.33	69.99	
	.23	41.02	49.22	45.63	54.75	50.19	60.22	54.76	65.71	59.82	71.18	63.88	76.66	
	.25	44.64	53.56	49.6	59.52	54.56	65.47	59.62	71.42	64.48	77.37	69.44	83.82	
	.26	46.42	55.7	51.58	61.89	56.74	68.08	61.9	74.28	67.06	80.46	72.22	86.66	
	.29	51.78	62.13	57.53	69.03	63.29	75.94	69.04	82.84	74.8	89.76	80.55	96.66	
	.3125	55.8	66.96	62	74.4	68.2	81.84	74.4	89.28	80.6	96.72	86.8	104.16	
	.33	58.92	70.7	65.47	78.56	72.02	86.42	78.57	94.28	85.11	102.13	91.66	109.99	
	.35	62.5	76	69.44	83.32	76.38	91.66	83.33	99.99	90.27	106.32	97.22	116.66	
	.375	66.96	80.35	74.4	89.28	81.84	98.2	89.28	107.13	96.72	116.06	104.16	124.99	
	.1875	31.26	37.5	34.72	41.66	38.19	45.82	41.66	49.99	45.13	54.15	48.68	58.33	90 inches
	.21	35	42	38.88	46.65	42.77	51.32	46.66	55.99	50.55	60.66	54.44	65.32	
	.23	38.33	45.99	42.59	51.10	46.85	56.22	51.11	61.33	55.37	66.44	59.62	71.54	
	.25	41.66	49.99	46.29	55.54	50.92	61.1	55.55	66.66	60.18	72.21	64.81	77.77	
	.26	43.33	51.99	48.14	57.76	52.95	63.55	57.77	69.32	62.59	75.1	67.4	80.88	
	.29	48.33	57.99	53.7	64.44	59.07	70.8	64.44	77.32	69.81	83.77	75.18	90.21	
	.3125	52.08	62.49	57.86	69.43	63.65	76.38	69.44	83.32	75.23	90.27	81.01	97.21	
	.33	55	66	61.11	73.33	67.22	80.66	73.33	87.99	79.44	95.32	85.55	102.66	
	.35	58.33	69.99	64.81	77.77	71.29	85.54	77.77	93.82	84.25	101.1	90.72	108.88	
	.375	62.5	75	69.44	83.32	76.38	91.66	83.33	99.99	90.27	106.32	97.22	116.66	
	.1875	29.29	35.14	32.55	39.06	35.8	42.96	39.06	46.87	42.31	50.77	45.57	54.68	96 inches
	.21	32.81	39.37	36.45	43.74	40.1	48.12	43.75	52.5	47.39	56.86	51.04	61.24	
	.23	35.98	43.11	39.98	47.91	43.92	52.7	47.91	57.49	51.9	62.28	55.9	67.08	
	.25	39.06	46.87	43.4	52.08	47.74	57.28	52.08	62.49	56.42	67.67	60.76	72.91	
	.26	40.62	48.74	45.14	54.16	49.65	59.58	54.16	64.99	58.78	70.53	63.19	75.82	
	.29	45.31	54.37	50.34	60.4	55.38	66.45	60.41	72.49	65.45	78.54	70.48	84.57	
	.3125	48.82	58.58	54.25	65.1	59.67	71.6	65.1	78.12	70.52	84.62	75.95	91.14	

.33	51.53	61.87	57.29	68.74	63.02	75.62	68.76	82.5	74.47	89.36	80.2	98.24
.35	54.63	65.61	60.76	72.91	66.83	80.19	72.91	87.49	78.99	94.78	85.06	102.07
.375	58.53	70.29	65.1	78.12	71.61	85.93	78.12	93.74	84.63	101.55	91.14	109.6

NOTE.—At the heads of the double columns will be found the tensile strength of the plates *per square inch of section*, also one-sixth of that amount. The pressures allowable on single-riveted boilers will be found in the first divisions of the double columns under the tensile strength and opposite the diameters and thickness; and, in the second divisions, the pressures allowable on boilers where all the rivet holes have been fairly drilled and no part of such holes has been punched, and the longitudinal laps of their cylindrical parts double riveted.

The pressure for any dimension of boiler not found in the above table must be ascertained in the manner prescribed in section 2, Rule II.

RULE III.—BOATS, RAFTS, BULKHEADS, AND LIFE-SAVING APPLIANCES.

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STEPS, LADDERS, EXTRA STEERING APPARATUS.

(III)

1. Every steamer or barge carrying passengers shall be provided with suitable ladders to enable passengers to descend conveniently to the lifeboats, such ladders to be placed near each side of the vessel. § 4484, R. S.

Every steam vessel shall be provided with sufficient means of escape from the lower to the upper deck, or vice versa, and every steamer of 50 tons or over carrying passengers shall be provided with permanent stairways forward and aft, except where said stairways on towing boats would interfere with towing bitts.

Extra steering apparatus, consisting of relieving tackles or tiller, must be provided for all steamers.

LIFEBOATS, LIFE RAFTS, FLOATS.

CAPACITY REQUIRED.

2. The capacity of all lifeboats shall be determined by the following rule: Measure the length and breadth outside of the planking or plating and the depth inside at the place of minimum depth. The product of these dimensions multiplied by .6 resulting in the nearest whole number shall be deemed the capacity in cubic feet. §§ 4481, 4488, R. S.

To determine the number of passengers a boat is to carry, divide the result by 10 for ocean, lake, bay, and sound steamers; and for river steamers divide the result by 8: *Provided, however,* That such boats shall in all cases have sufficient room, free board, and stability to safely carry such number of passengers, which fact must be determined by actual experiment in the water at the time of the first inspection of said boats after the passage of this rule. Where a vessel is carrying boats of different types or capacities, at least one boat of each type or capacity shall be so tested.

EXAMPLE.

The carrying capacity of a boat 20 feet in length, 6 feet in breadth, and $2\frac{1}{2}$ feet in depth will be determined as follows:

For ocean, lake, bay, and sound steamers,

$$\frac{20 \times 6 \times 2\frac{1}{2} \times .6}{10} = \frac{180}{10} = 18 \text{ persons.}$$

For river steamers, same boat, $\frac{180}{8} = 22$ persons.

CONSTRUCTION.

3. All lifeboats shall be substantially built.

Metallic lifeboats of 20 feet length and under shall be constructed of metal of not less thickness than No. 18 wire gauge. Boats 20 to $24\frac{1}{2}$ feet in length shall have a

§§ 4405, 4481, R. S.

- (III, 3) thickness of metal not less than No. 16 wire gauge for their middle half length, and their ends of not less than No. 18 wire gauge. Boats longer than 24 feet shall be built according to specifications approved by the Supervising Inspector-General.

The wire-gauge numbers given in this paragraph are Birmingham standard.

The air tanks of all metallic lifeboats built after June 30, 1906, shall be provided with air-pump connections of $\frac{1}{2}$ -inch outside diameter, for the purpose of testing the air-tightness of said tank.

All seams and joints shall be properly double riveted.

Life-raft cylinders, if over 15 feet in length, must be constructed of metal of not less thickness than No. 18 wire gauge, and if 15 feet or less in length, of metal of not less thickness than No. 20 wire gauge. The retaining bands which secure the cylinders to the frames should be made in halves so that the cylinders may be detached without difficulty for the purpose of inspection, cleaning, and painting, as required by section 6, Rule III.

All life-raft cylinders, except those 6 feet or less in length, must be divided by water-tight bulkheads into not less than three compartments of equal lengths, and each compartment shall be provided with a suitable air-pump connection, of one-half inch outside diameter, fitted with air-tight cap.

The inspection of a metallic cylindrical life raft will include the testing each compartment with an air pressure of 5 pounds to the square inch.

All lifeboats shall have air-tight tanks of sufficient capacity to float boats when full of water and when loaded to allowed capacity.

Only countersunk-headed rivets shall be used in the construction of metallic lifeboats and life rafts.

The above provisions of this section shall take effect only as to boats and rafts constructed after June 30, 1905.

All joints of the air tanks shall be both riveted and soldered.

The circumferential as well as the longitudinal seams of life-raft cylinders must be riveted, and on rafts constructed after June 30, 1905, shall also be soldered.

The framework connecting the cylinders of metallic life rafts must be substantially built and capable of resisting the strain which tends to break the cylinders apart when the raft is broadside on in surf or seaway.

All metallic lifeboats hereafter built shall be furnished with an automatic plug.

DRAWINGS, SPECIFICATIONS, NAME PLATE.

§ 4405, R. S.

4. Builders of lifeboats and life rafts shall furnish the Supervising Inspector-General with drawings and specifications showing and explaining the construction of the same, and the physical characteristics (tensile strength

and ductility) of the metal used. They shall also affix a plate or other device to each boat and raft, having thereon the builder's name, number of boat or raft, date of construction of boat or raft, cubical contents of boat or raft, and number of persons said boat or raft will carry, as determined by the rules of the Board of Supervising Inspectors. (III, 4)

This section shall apply to all boats and rafts built after June 30, 1905.

EQUIPMENTS.

5. All lifeboats must have the following equipment: § 4405, R. S.
A properly secured life line the entire length on each side, and such line must be festooned with a seine float in each bight, the bights to be not longer than 3 feet; 1 boat painter, of not less than 2½-inch manila rope (about .9 inch diameter), properly attached and of a suitable length; a full complement of oars, and 2 spare oars of suitable length; not less than 4 rowlocks, and 2 spare ones, all attached to boat; 1 steering oar, with rowlock or becket, or 1 rudder, with yoke and suitable yoke ropes; 1 boat hook, and 1 bucket with lanyard attached, and on wooden boats 2 plugs for each drain hole, attached with lanyard or chains; also at least 2 life-preservers, or wooden life floats where the same are allowed by law.

All life rafts must be equipped with 2 life lines, securely fastened to the gunwales; 1 painter, of 2½-inch manila rope of a suitable length; not less than 4 oars of suitable size; 2 paddles, each of not less than 5 feet in length, the blade of each to be of not less area than one-half that of the blade of one of the oars of such raft; 4 rowlocks; 1 steering oar, with rowlock or becket, and 1 boat hook.

All the equipment mentioned in this section shall be kept in good condition for immediate use.

HOW LIFEBOATS MUST BE CARRIED.

6. All lifeboats, on vessels carrying passengers for hire, must, if practicable, be carried under substantial davits or cranes, with two separate davits or cranes for each boat so carried, or with a single crane for each boat when such single crane is properly adapted to lower said boat; but if it is not practicable so to carry all the lifeboats required, the remainder must be stowed near at hand, so as to be easily and readily launched when required. § 4405, R. S.

All boats under davits must be arranged so that they can be simultaneously launched. Such davits or cranes, and the blocks and the falls thereof, on all passenger vessels except ferryboats, must be of sufficient strength to carry the boat with its full load.

It shall be the duty of the master or officer in charge of all such vessels to see that the boat davit falls shall at all times be in readiness for immediate use, and protected from ice, and not painted, and such boat davit falls on all

- (III, 6) boats not swung out at boat drills shall be cut adrift and overhauled; and it shall be unlawful to stow in any lifeboat articles other than those required by law and regulations. Lifeboats and life rafts must be stripped, cleaned, painted, and thoroughly overhauled at least once in every year. All lifeboats shall have their cubical contents painted on the stem in black letters and figures not less than three-fourths of an inch high on a white ground.

LIFEBOATS REQUIRED.

§§ 4481, 4488, R. S. 7. All vessels of 50 gross tons or over not carrying passengers, navigated under the provisions of Title LII, Revised Statutes of the United States, shall at all times be equipped with sufficient boat capacity to carry the crew of said vessel with safety, capacity to be determined by the rules of the Board of Supervising Inspectors: *Provided*, That steamers of less than 150 gross tons, while engaged exclusively in harbor towing, may substitute one or more life rafts for the lifeboats required, when the lifeboats interfere with the practical operation of the steamer, and such substitution may be made with safety, it being understood that when such vessel engages in service other than harbor towing she must be equipped with boats as required by the Rules and Regulations.

§ 4481, R. S. 8. All vessels of less than 50 gross tons, navigated under the provisions of Title LII, Revised Statutes of the United States, and not carrying passengers, must be equipped with boats or rafts as in the opinion of the inspectors may be necessary to secure the safety of all persons on board in case of disaster.

§§ 4481, 4488, R. S. 9. All vessels inspected under the provisions of Title LII, Revised Statutes of the United States, carrying passengers for hire, shall be required to be provided with lifeboats according to the following tables: *Provided*, That no vessel shall be required to have more lifeboat capacity than sufficient to carry all the passengers and crew allowed by the certificate of inspection. And at least one lifeboat shall be of metal, unless exempted by the supervising inspector of the district where the vessel was last inspected: *It is further provided*, That all such vessels of 50 gross tons and upward must have one working boat in addition to the lifeboats required by the tables. .

§ 4481, R. S. 10. *Cubical capacity of lifeboats required on passenger vessels navigating rivers other than the Red River of the North and rivers whose waters flow into the Gulf of Mexico, except vessels of 150 gross tons and under, hereinafter provided for.*

	Cubic feet.
Vessels over 150 and not over 300 gross tons	360
Vessels over 300 and not over 600 gross tons	540
Vessels over 600 and not over 900 gross tons	720
Vessels over 900 and not over 1,200 gross tons	900
Vessels over 1,200 gross tons	1,080

11. *Cubical capacity of lifeboats required on passenger vessels navigating the Red River of the North and rivers whose waters flow into the Gulf of Mexico, excepting vessels of 150 gross tons and under, hereinafter provided for.* (III) § 4481, R. S.

	Cubic feet.
Vessels over 150 and not over 300 gross tons	240
Vessels over 300 and not over 600 gross tons	360
Vessels over 600 and not over 900 gross tons	480
Vessels over 900 and not over 1,200 gross tons	600
Vessels over 1,200 gross tons	720

12. *Cubical capacity of lifeboats required on passenger vessels navigating northwestern lakes, bays, and sounds, except vessels of 150 gross tons and under, hereinafter provided for.* §§ 4481, 4488, R. S.

Gross tons.	Capacity of boats.	Gross tons.	Capacity of boats.
Vessels over—	<i>Cubic feet.</i>	Vessels over—	<i>Cubic feet.</i>
150 and not over 200	360	2,000 and not over 2,500	1,620
200 and not over 300	540	2,500 and not over 3,000	1,800
300 and not over 400	720	3,000 and not over 3,500	1,980
400 and not over 500	900	3,500 and not over 4,000	2,160
500 and not over 1,000	1,080	4,000 and not over 4,500	2,340
1,000 and not over 1,500	1,260	4,500 and not over 5,000	2,520
1,500 and not over 2,000	1,440	5,000 and not over 5,500	2,700

Steamers above 5,500 gross tons shall be furnished with an additional boat of not less than 495 cubic feet capacity for each additional 500 tons burden or fraction thereof.

13. *Cubical capacity of lifeboats required on passenger vessels navigating oceans, except vessels of 150 gross tons and under, hereinafter provided for.* § 4488, R. S.

Gross tons.	Total capacity of boats.	Gross tons.	Total capacity of boats.
Vessels over—	<i>Cubic feet.</i>	Vessels over—	<i>Cubic feet.</i>
150 and not over 200	540	9,500 and not over 10,000	7,920
200 and not over 300	720	10,000 and not over 10,500	8,145
300 and not over 400	1,080	10,500 and not over 11,000	8,370
400 and not over 500	1,260	11,000 and not over 11,500	8,595
500 and not over 1,000	1,620	11,500 and not over 12,000	8,820
1,000 and not over 1,500	1,800	12,000 and not over 12,500	9,045
1,500 and not over 2,000	2,160	12,500 and not over 13,000	9,270
2,000 and not over 2,500	2,340	13,000 and not over 13,500	9,495
2,500 and not over 3,000	2,700	13,500 and not over 14,000	9,720
3,000 and not over 3,500	2,880	14,000 and not over 14,500	9,945
3,500 and not over 4,000	3,240	14,500 and not over 15,000	10,170
4,000 and not over 5,000	3,420	15,000 and not over 15,500	10,395
5,000 and not over 5,500	3,870	15,500 and not over 16,000	10,620
5,500 and not over 6,000	4,320	16,000 and not over 16,500	10,845
6,000 and not over 6,500	4,770	16,500 and not over 17,000	11,070
6,500 and not over 7,000	5,220	17,000 and not over 17,500	11,295
7,000 and not over 7,500	5,670	17,500 and not over 18,000	11,520
7,500 and not over 8,000	6,120	18,000 and not over 18,500	11,745
8,000 and not over 8,500	6,570	18,500 and not over 19,000	11,970
8,500 and not over 9,000	7,020	19,000 and not over 19,500	12,195
9,000 and not over 9,500	7,470	19,500 and not over 20,000	12,420

Vessels of over 20,000 gross tons shall be provided with an additional boat capacity of 225 cubic feet for each additional 500 gross tons, or fraction thereof.

14. Not more than one-third of the lifeboat capacity required on any vessels may be substituted by its equivalent in approved life rafts or approved collapsible (folding) lifeboats. § 4488, R. S.

(III)
§ 4405, R. S.

15. Boats required on ocean vessels of 150 gross tons and over shall be of suitable dimensions and of not less than 180 cubic feet capacity, and every such boat shall be equipped with 2 life lines, a painter, rudder, yoke and yoke ropes, as already specified in section 5; also a full set of oars and rowlocks, 1 spare oar and rowlock, 1 steering oar with rowlock or becket, 2 boat hooks, 1 bailer, 1 bucket; 1 lugsail, with sheet, tack, and reef earings, in a water-tight canvas bag; 1 mast and 1 yard with necessary rigging, 1 boat compass, 1 lantern, 1 gallon can of illuminating oil, at least 1 box of matches wrapped in a water-proof package and carried in a box attached to the underside of the stern thwart, 1 breaker of fresh water of at least 15 gallons capacity, 1 sealed tin containing 25 pounds of hard bread, 1 water-proof canvas bag 6 inches diameter and 15 inches long containing palm and needles, sail twine, marline, marline spike, hatchet, smoker's flint and steel, a small bottle of spirits of turpentine for priming lantern wicks. Every such lifeboat shall also be provided with 6 night distress signals in a metallic case.

The distress signals prescribed in this section must not be fired by a friction device. The chemical device known as "Swedish match," and signals or fireworks ignited by friction, shall not be allowed in a steamer's equipment or stores.

Provided, That all pleasure steamers, and all other steamers over 150 tons but not exceeding 750 tons, limited by their certificates of inspection to routes not more than 15 miles from any harbor, shall not be required to have more than one of the lifeboats to be of 180 cubic feet capacity, but such lifeboat of 180 cubic feet capacity shall be equipped in accordance with this section. Nothing, however, in this proviso shall exempt any such steamer from carrying the aggregate cubic feet of lifeboat capacity provided for by the tables; and all lifeboats of less than 180 cubic feet capacity referred to in this proviso shall be equipped according to the provisions of section 5, Rule III.

§§ 4481, 4488, R. S. 16. *Cubical capacity of boats required on passenger vessels of 150 gross tons and under navigating oceans, lakes, bays, sounds, and rivers.*

	Cubic feet.
Vessels not over 10 gross tons.....	75
Vessels over 10 and not over 30 gross tons.....	90
Vessels over 30 and not over 50 gross tons.....	120
Vessels over 50 and not over 100 gross tons.....	135
Vessels over 100 and not over 150 gross tons.....	165

SAIL-VESSEL EQUIPMENT.

§ 4417, R. S.

17. Local inspectors inspecting sail vessels of over 100 gross tons, carrying passengers on the ocean or on the high seas, under the provisions of section 4417, Revised Statutes, as amended by the act of Congress approved December 21, 1898, shall require such sail vessels to be

equipped with a life-preserver for every person on board, (III, 17) passengers and crew, and with lifeboats, in accordance with the requirements of the rule applying to ocean steamers carrying passengers.

MARKING CAPACITY ON LIFE RAFTS.

18. There shall be stenciled in a conspicuous place on each life raft now in use the number of persons said life raft can carry, as hereinafter provided. § 4405, R. S.

CAPACITY OF COLLAPSABLE BOATS, CARLEY LIFE FLOATS, AND LIFE RAFTS.

Engelhardt collapsable boats.

19. 12-foot boat, except when carried on davits, 17 persons. § 4488, R. S.

20-foot boat, except when carried on davits, 28 persons.

Carley life floats.

No. of float.	Size of float.	Diameter of tube.	Minimum number of compartments.	Number of persons carried and allowed.
		<i>Inches.</i>		
1	8 by 4 feet	14½	.....	10
2	8 by 5 feet	16½	.....	11
3	10 by 6 feet	17½	.....	18
4	12 by 8 feet	20½	.....	33
5	3 feet 6 inches by 6 feet	12	8	6
6	3 feet 9 inches by 6 feet 6 inches..	13	8	7
7	4 by 7 feet	14	8	9
8	4 feet 6 inches by 7 feet 6 inches..	14	10	11
9	4 feet 6 inches by 8 feet 6 inches..	14	12	13
10	5 by 8 feet	14	12	13
11	.....do	15	12	13
12	5 by 9 feet	15	14	16
13	5 by 10 feet	15	14	17
14	6 by 10 feet	16	.....	28
15	6 feet 6 inches by 10 feet 6 inches..	17	.....	31
16	7 by 12 feet	18	.....	41
17	8 by 12 feet	19	.....	45
18	9 by 14 feet	20	.....	67
19	5 by 8 feet	14½	.....	18
20	5 by 10 feet	15½	.....	20

Balsa wood life raft.

11 feet by 4½ feet, 12-inch cylinders, 7 persons.

Barstow life rafts.

Length of tank.	Width of tank.	Depth of tank.	Number of persons carried and allowed.
<i>Feet.</i>	<i>Feet.</i>	<i>Inches.</i>	
14	6	14	36
14	5	14	36
12	5	14	28
12	4	14	25
10	4	14	24
8	4	14	16
6	4	14	12
5	3	12	8

(III, 19)

Cylinder life rafts, approved specifications.

Length over all.	Width outside of guards.	Diameter of cylinders.	Number of persons carried and allowed.
<i>Ft. in.</i>	<i>Ft. in.</i>	<i>Inches.</i>	
16 8	6 7½	22	28
16 6	5 8	16	16
14 0	5 6	16	14
12 2	5 7	16	14
8 0	5 2	16	7

§ 4488, R. S.

20. Engelhardt collapsable lifeboats, Carley life floats, and the three kinds of life rafts specified in the preceding section, of different dimensions from the foregoing, may be tested by the supervising inspector of the district in which they are made, after their specifications have been approved by the Supervising Inspector-General, and allowed the number of persons which they actually carry in said trial, the Supervising Inspector-General issuing a circular letter giving the rating allowed after trial of each new size.

The Engelhardt collapsable (folding) lifeboat shall be rated as a lifeboat when extended and fully equipped under the davits, and shall be measured in accordance with the rules for measuring lifeboats (section 2, Rule III). The depth of the boat shall be taken from the inside of the bottom planking of the bottom. The cubical capacity thereof shall be determined by multiplying the length, breadth, and depth together, and multiplying that product by 0.7.

KAPOK AND LOOSE GRANULATED CORK LIFE-PRESERVERS.

§ 4488, R. S.

21. All life rafts and life-preservers made in whole or in part of loose granulated cork shall be excluded from use on all vessels.

All kapok life-preservers heretofore approved by this Board shall be excluded from use on all vessels.

Provided, That this section shall take effect on and after May 1, 1905.

EQUIPMENT FOR BARGES.

§ 4492, R. S.

22. Barges carrying passengers on any routes shall have a life-preserver or float for each and every person allowed to be carried, and in addition thereto shall be supplied with 10 buckets, 2 barrels of not less than 40 gallons each, and 3 axes, 1 hand fire pump capable of discharging 100 cubic inches of water at each stroke, and sufficient length of regulation hose to reach to all parts of the vessel, and 2 yawl boats of not less than 120 feet capacity each, equipped with 4 oars each.

All barges carrying passengers shall be inclosed by a good and substantial rail not less than 3 feet high.

LIFEBOATS FOR SMALL STEAM VESSELS.

(III)

23. The lifeboat referred to in the table for passenger steamers of 10 tons or under must be either carried or towed at all times when being navigated with passengers on board. § 4488, R. S.

24. All open steam launches or other steam vessels of 5 gross tons or less, used for pleasure purposes only, shall not be required to carry a lifeboat. § 4488, R. S.

LINE-CARRYING GUNS, ROCKETS, AND PROJECTILES.

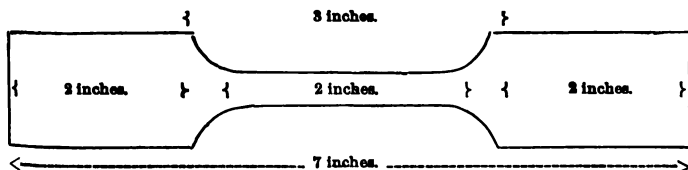
25. All ocean steam pleasure vessels and ocean steam vessels carrying passengers, except vessels of 150 gross tons and under, shall be provided with at least three line-carrying projectiles and the means of propelling them, such as may have received the formal approval of the Board of Supervising Inspectors. § 4488, R. S.

All cast bronze guns of the Lyle type, approved by the Board of Supervising Inspectors, January, 1890, for use on board of steam vessels as a means of propelling line-carrying projectiles, shall be composed of an alloy which shall have a tensile strength of not less than 52,000 pounds per square inch of section and a ductility of not less than 26 per cent, as shown by reduction of area.

All Hunt's line-carrying guns, large; Hunt's line-carrying guns, small; Hunt guns No. 2, and Lyle line-carrying guns shall be tested in the presence of an inspector or assistant inspector by firing the same three rounds. One round, at least, must carry the regular service projectile, with a service line attached, a distance of at least 1,500 feet. The other two rounds must be fired with the same charge of powder, and the projectile must have the same weight as the service projectile, but no line need be attached.

Provided, That when the Hunt line-carrying gun, small, is tested, the distance the projectile must carry the line need not exceed 800 feet.

At least one sample of the material shall be taken from the lower portion of the sinking head in each gun, and to be not less than 7 inches in length, 2 inches in width, $\frac{1}{2}$ inch in thickness, and have a section .5 by .75 inch over a length of 2 inches, according to the following diagram:



All samples shall be furnished to the supervising inspector of the district for testing, and shall be accompanied by an affidavit of the manufacturer that such

(III, 25) samples were taken from guns, each of which shall be distinctly marked, so as to be readily identified by the inspectors.

§ 4488, R. S. 26. When approved rockets are used instead of guns, there shall be, in every case, at least three of said rockets; and all steamers that are required under the law to carry line-carrying projectiles and the means of propelling them shall be supplied auxiliary thereto with at least 800 feet of 3-inch manila line for vessels of 100 to 500 gross tons and 1,500 feet of said line for steamers above 500 gross tons, such auxiliary line to be kept always ready for use in connection with the gun and rocket, and which lines shall not be used for any other purpose.

§ 4406, R. S. 27. The test rounds required by section 25 must be fired from the gun when mounted on its own carriage, lashed as it would be in shipboard use. The line must be coiled, faked or reeled in its own faking box, or reel; and gun, carriage and line box, or reel, must all bear the same number, and must be initialed by the inspector, whose report, giving number, date, and result, will be filed in the office of the supervising inspector of the district in which the test is made.

§ 4406, R. S. 28. The supervising inspector will furnish the manufacturer of any Lyle or Hunt line-carrying guns a copy of the report on each gun tested and inspected, as provided in sections 25 and 27.

The master of every vessel equipped with a line-carrying gun shall drill his crew in the use thereof, and fire said gun at least once in every three months, using the service projectile and line.

It shall be the duty of the inspectors, at the annual inspections, to see that these drills are entered on the log of the vessels.

LIFE-PRESERVERS.

§ 4488, R. S. 29. Every vessel inspected under the provisions of Title LII, Revised Statutes of the United States, shall be provided with one good life-preserver, having the approval of the Board of Supervising Inspectors, for each and every person allowed to be carried on said vessel by the certificate of inspection.

Every life-preserver adjustable to the body of a person shall be made of good cork blocks or other suitable material approved by the Board of Supervising Inspectors, with belts and shoulder straps properly attached, and shall be so constructed as to place the device underneath the shoulders and around the body of the person wearing it. All such life-preservers shall be not less than 52 inches in length when measured laid flat; and every cork life-preserver shall contain an aggregate weight of at least 6 pounds of good cork, and every life-preserver shall be capable of sustaining for a continuous period of twenty-four hours an attached weight so arranged that

whether the said weight be submerged or not there shall be a direct downward gravitation pull upon said life-preserver of at least 20 pounds. (III, 29)

All life-preservers shall be covered with material of sufficient weight and strength to fully protect the contents, such material to be of a strength equivalent to unbleached cotton twill not less than 6 ounces in weight to a section of 30 by 36 inches. Such covering on each life-preserver shall be of one piece only, and the outside longitudinal edges of the covering at the seam must be turned to a roll and closely rope-stitched. Each life-preserver shall have two shoulder straps of heavy double-woven cotton tape $1\frac{1}{2}$ inches in width, each strap to be made of one piece only, and such straps shall be not less than 23 inches net in length, and shall be securely attached to the covering of the life-preserver by not less than four rows of stitching and at not less than two places for each strap, the rear ends of the straps to be sewed on not less than 3 nor more than 5 inches from the center of the upper edge of the jacket, measured to the center of the straps. The said shoulder straps shall be securely attached to each other by not less than four rows of stitching at the point where they cross each other on the back, the forward ends to be sewed on the jacket in such a position as to allow it to be opened out to its full length without straining the cross seizing. There shall also be on each life-preserver a breast or button strap of heavy double-woven cotton tape 1 inch wide and 12 inches long, one end of which shall be securely fastened to one shoulder strap by four rows of stitching at a point 4 inches above the jacket, and the other end of such breast strap shall be doubled back 2 inches and a buttonhole worked through both parts. A button of noncorrosive material shall be securely sewed on the other shoulder strap 4 inches above the jacket. There shall also be on each life-preserver a belt of heavy double-woven cotton tape $1\frac{1}{2}$ inches wide, extending along the middle line on the outside of the jacket, securely sewed to the covering of the life-preserver at not less than six places, the end blocks being left free, and the ends of the belt to extend 12 inches beyond the ends of the jacket. All thread used in the construction of life-preservers must be linen of a size not less than No. 12 Coates's or Clark's six-cord cotton, and the seams must be sewed in such a manner that the straps can not be ripped off without tearing the material. All seams and other machine sewing on life-preservers shall be with a short lock stitch, not less than 8 stitches to the inch.

Blocks of compressed or consolidated cork when used in life-preservers must weigh in the aggregate not less than 6 pounds to each life-preserver, and must be so constructed that said blocks will sustain, without disintegration or substantial expansion, a submersion test satisfactory to the inspector examining the same, and that at the

- (III, 29) expiration of such test must have the buoyancy above required. Where the blocks of life-preservers are made up of separate pieces of cork, said pieces shall be fastened with noncorrosive materials.

After the approval of this rule no life-preserver shall be passed at the factory inspection which does not fulfill the foregoing requirements, but life-preservers now in use or already passed at factory inspection may be used on board vessels, provided they are constructed in accordance with the laws and regulations in force up to the date of approval of this section, and are in good and serviceable condition: *Provided, however,* That nothing in this section shall be construed so as to allow the use after May 1, 1905, of life-preservers made of kapok or loose granulated cork: *Provided,* That all block-cork life-preservers now in use that have been approved by this Board shall be passed by the local inspectors when they are not less than 48 inches in length and have the other necessary requirements. Inspectors are further required to direct such life-preservers to be distributed throughout the cabins, staterooms, berths, and other places convenient for passengers on such steamers; and there shall be a printed notice posted in every cabin and stateroom and in conspicuous places about the decks, informing passengers of the location of life-preservers and other life-saving appliances, and of the mode of applying or adjusting the same. Life-preservers on passenger, excursion, and ferry steamers when stowed overhead must be so supported that they can be quickly released and distributed among the passengers, and the inspector must satisfy himself as to the efficiency of the means used for such purpose by actual experiment. And when such life-preservers are stowed overhead at a height greater than 7 feet from the deck below efficient means must be provided for such immediate release and distribution, to be operated by persons standing on the deck below.

The supervising inspector of the district shall detail a local or assistant inspector to any place where life-preservers are manufactured, whose duty it shall be to test and examine all life-preservers manufactured at that place and satisfy himself that such life-preservers are in accordance with the requirements of the Board of Supervising Inspectors. When found to be in accordance with the requirements, the inspector shall stamp them with a stamp bearing the initials of his name and the date of examination, and certifying that they have been examined and passed. When life-preservers are so stamped it shall be prima facie evidence that they comply with the requirements of law and regulations as to their original construction, and they may thereafter be accepted by inspectors, in their discretion, as being in accordance with the rules and regulations of the Board of Supervising Inspectors.

WOODEN LIFE FLOATS.

(III)

30. *Provided*, That vessels navigating rivers and carrying passengers shall be allowed to use wooden floats, when made as approved by the Board of Supervising Inspectors, one for each deck or steerage passenger. § 4488, R. S.

When wooden life floats are used in accordance with the above paragraph, they shall be of the following dimensions: 4 feet in length, 14 inches in breadth, and 2 inches in thickness. The floats shall be made of well-seasoned white pine or of any other wood not exceeding white pine in weight per cubic foot.

RING BUOYS.

Whenever they deem it necessary for the safety of passengers or crew, inspectors may require a vessel to carry, not to exceed four, ring buoys, either with or without attached lines. It is recommended that ring buoys hung on a steamer's gangways have the line attached to both the vessel and the buoy, and that those hung on the superstructure have no line and be as light as is possible with the necessary buoyancy.

STEAMER'S NAME ON EQUIPMENTS.

31. All the equipments of a steamer, such as buckets, hose, axes, boats, oars, rafts, life-preservers, floats, barrels, and tanks, shall be painted or branded with the name of the steamer upon which they are used. § 4405, R. S.

DRAGS OR FLOATING ANCHORS.

32. Drags or floating anchors shall be constructed so as to be capable of being compactly stowed near the head of the ship. § 4488, R. S.

Steamers navigating the ocean must be provided with at least one drag, of area as follows: For steamers of 400 gross tons and under, not less than 25 superficial feet; for steamers of over 400 gross tons, the area of drag shall not be less than that determined by adding to 25 square feet 1 square foot for each additional 25 gross tons above 400 tons. Example: The area of a drag on a vessel of 1,000 tons will equal:

$$25 + \frac{1,000 - 400}{25} = 49 \text{ square feet.}$$

Steamers of over 5,000 gross tons may be equipped with two or more drags, provided the total area is not less than that required by this rule. Steamers whose routes do not extend *off anchorage* are not required to have drags or floating anchors on board.

(III)

BULKHEADS.

§ 4490, R. S.^a

33. Every seagoing steamer and every steamer navigating the great Northern and Northwestern lakes carrying passengers for hire shall have not less than three water-tight cross bulkheads. Such bulkheads shall reach to the main deck in single-decked vessels, otherwise to the deck next below the main deck. The collision bulkhead, however, shall in every case reach to the deck next above the load water line. For wooden hulls they shall be fastened to suitable framework, which framework must be securely attached to the hull and calked. For iron hulls they shall be well secured to the framework of the hulls and strengthened by stanchions of angle iron placed not more than 2 feet from center to center. One of the bulkheads must be placed forward and one abaft of the engines and boilers.

The third or collision bulkhead must be placed not nearer than 5 feet from the stem of the vessel. Iron bulkheads must be made not less than one-fourth of an inch in thickness, and wooden bulkheads must be of equal strength and covered with metal plates not less than one-sixteenth of an inch in thickness.

The covering of wooden bulkheads on the forward side of the one forward of the engines and boilers, and on the after side of the one abaft the engines and boilers, shall be at the discretion of the inspectors; but no discretion is allowed as to the covering on the sides next to the engines and boilers, on bulkheads built after the approval of this rule (July 12, 1906).

34. Wherever the words "passenger steamer," "steamer carrying passengers," or "vessel carrying passengers" occur in this entire rule (Rule III), the said words shall be construed to mean, and apply to, only vessels carrying passengers for hire, and the words "carrying passengers" shall be construed to mean "carrying passengers for hire."

RULE IV.—FIRE APPARATUS.

	Section.
Axes for passenger steamers.....	1
Axes for other than passenger steamers.....	2
Axes, where located and how kept.....	4
Barrels for passenger steamers.....	1
Barrels for other than passenger steamers.....	2

^a SEC. 3. That steam vessels of one hundred tons burden or under engaged in the coastwise bays and harbors of the United States may be licensed by the United States local inspectors of steam vessels to carry passengers or excursions on the ocean or upon the Great Lakes of the North or North west, not exceeding fifteen miles from the mouth of such bays or harbors, without being required to have the three water-tight cross bulkheads provided by section forty-four hundred and ninety of the Revised Statutes for other passenger steamers: *Provided*, That in the judgment of the local inspectors such steamers shall be safe and suitable for such navigation without danger to human life, and that they shall have one water-tight collision bulkhead not less than five feet abaft the stem of said steamer. (Act approved July 9, 1886.)

Section.

(IV)

Bilge pipes required.....	14
Buckets for passenger steamers.....	1
Buckets for other than passenger steamers.....	2
Fire extinguishers, chemical, regulations regarding.....	13
Pipes for conducting water from fire pumps, how constructed.....	15
Pipes for carrying steam into hold, how constructed.....	7
Pipes leading from pumps, diameter of.....	10
Pumps or equivalents for certain steamers.....	8
Pumps must be of certain capacity.....	9
Pumps, rotary, allowed under certain conditions.....	11
Pumps for testing boilers.....	12
Pumps, what constitutes an equivalent for certain steamers.....	13
Pumps, steam fire, how equipped.....	14
Siphon steam pump allowed under certain conditions.....	16
Sounding pipe required in each compartment.....	14
Spark arresters for certain western steamers.....	6
Tarpaulin, certain articles to be covered with.....	5
Water, provisions for keeping, for fire.....	3

1. All steamers carrying passengers are required to be provided with fire buckets, barrels, and axes, as follows: §§ 4426, 4472, 4483, R. S.

Gross tons.	Barrels.	Buckets.	Axes.
All steamers not over 10 tons		2	1
All steamers over 10 tons and not over 25 tons		4	1
All steamers over 25 tons and not over 50 tons	1	6	2
All steamers over 50 tons and not over 100 tons	1	8	2
All steamers over 100 tons and not over 200 tons.....	2	18	4
All steamers over 200 tons and not over 500 tons	4	24	6
All steamers over 500 tons and not over 1,000 tons.....	6	35	8
All steamers over 1,000 tons.....	8	50	10

2. For freight and towing steamers:

§ 4426, R. S.

Gross tons.	Barrels.	Buckets.	Axes.
All steamers not over 10 tons		2	1
All steamers over 10 tons and not over 25 tons		4	1
All steamers over 25 tons and not over 50 tons	1	6	2
All steamers over 50 tons and not over 100 tons	1	8	2
All steamers over 100 tons and not over 200 tons.....	1	12	2
All steamers over 200 tons and not over 500 tons	2	15	3
All steamers over 500 tons and not over 1,000 tons.....	3	20	4
All steamers over 1,000 tons.....	4	25	5

Provided, however, That tanks of suitable dimensions and arrangements, or buckets in sufficient number, may be substituted for barrels on all vessels. Five buckets shall be considered as equivalent to one barrel.

3. Fire buckets, barrels, or tanks must, when practicable, be constantly filled with water and in such positions on board as shall be most convenient for extinguishment of fire. §§ 4426, 4483, R. S.

4. All axes must be located so as to be readily found in time of need, must not be used for general purposes, and must be kept in good condition. §§ 4426, 4483, R. S.

5. All hay, straw, or other inflammable material carried on the open deck of any steamer carrying passengers shall be covered with a tarpaulin. § 4472, R. S.

6. All steamers on western rivers having their boilers § 4470, R. S.

- (IV, 6) situated so that the sparks from the fires may be driven back among combustible materials shall have a sheet-iron fender extending forward from the fire doors not less than 2 feet, at the height of the furnace fronts, and connecting with the same.

§ 4470, R. S.

7. The main pipes and their branches, on steamers carrying passengers or freight, to convey steam from the boilers to the hold and separate compartments of the same, except the cabins, shall not be less than $1\frac{1}{2}$ inches in diameter, except on steamers employed on western rivers, constructed prior to June 30, 1905, which steamers may use branch pipes not less than three-fourths of an inch in diameter. Steam pipes of not less than three-fourths of an inch in diameter must be led to all lamp lockers, oil rooms, and like compartments, which lamp lockers, oil rooms, and compartments, in all classes of vessels, must be wholly and tightly lined with metal. All branch pipes leading into the several compartments of the hold of the vessel shall be supplied with valves, the handles distinctly marked to indicate the compartment or parts of the vessel to which they lead.

These valves or their handles shall be placed in the most accessible part of the main deck of the vessel, and so arranged that all can be inclosed in a box or casing, the door of which shall be plainly marked with the words "Steam fire apparatus."

On all oil-tank steamers the valves, instead of being located near the hatches on the upper deck, shall be all in an accessible house in which the operator is well protected from heat and smoke.

Provided, That carbonic-acid gas or other extinguishing gases or vapors may be substituted in place of steam as aforesaid and for the above-described purposes, when such gas or vapor and the apparatus for producing and distributing the same shall have been approved by the Board of Supervising Inspectors: *Providing*, That the use of such apparatus shall be allowed by law.

§ 4471, R. S.

8. Steamers required to be provided with double-acting steam fire pumps or equivalents for throwing water shall be equipped with such pumps, according to their tonnage, as follows: Steamers under 3,000 tons shall have not less than one-third of one cubic inch pump-cylinder capacity for every gross ton. Steamers over 3,000 tons shall have pump cylinders of not less than 1,000 cubic inches capacity. This rule shall apply only to pumps installed after June 30, 1905, and all pumps now approved and in use or installed before said date shall be accepted if complying with the requirements of law and regulations in force at the time of the adoption of this rule.

Upon such steamers fire mains shall be led from the pumps to all decks, with sufficient number of outlets arranged so that any part of the steamer can be reached with water with the full capacity of the pumps and by means of a single 50-foot length of hose from at least one

of said outlets. On all classes of steamers every such pump shall be fitted with a gauge and a relief valve adjusted to lift at 100 pounds pressure. (IV, 8)

9. Steamers are not restricted to any particular proportions for fire pumps. Any dimensions that will attain the requirements specified in section 8, or greater in capacity, may be allowed: *Provided, however,* That all hydrant connections be supplied with suitable spanners. §4471, R. S.

10. The capacity of the pipes and hose leading from the pumps must in no case be less than that of the discharge opening of the pump: *Provided, however,* That the pipe and hose shall in no instance be less than 1½ inches in internal diameter. §4471, R. S.

And provided further, That steamers of 15 tons and under may be allowed to use hose of three-fourths of an inch internal diameter, but in no case shall it be less than the discharge opening of the pumps, it being further provided that open boats of less than 10 gross tons that are fully equipped with buckets, as required by these rules and regulations, shall not be required to carry hose.

11. A rotary pump, when driven by an engine independent of the main engine, may be considered as an equivalent for the double-acting fire pump, and used as such when equal to it in efficiency and capacity. §4471, R. S.

12. Any steamer having on board an independent steam pump and an auxiliary boiler suitably arranged and of sufficient strength and capacity for testing the boilers thereof; or if one of the hand fire pumps be suitably arranged and of sufficient strength and capacity for testing the boilers; or if the "doctor," so called, when arranged permanently for testing the boilers, is, in the judgment of the inspectors, suitable for the purposes intended, may be considered as having complied with the law requiring a pump for testing boilers. § 4471, R. S.

13. Any steamer of 50 gross tons or under, required to have a double-acting steam fire pump, and having in use on board a "doctor," so called, may be considered as having a lawful equivalent for such pump when such "doctor" has pipes attached to it leading to the upper and between decks, such pipes being provided with hose and valves, according to law; but the pipes and hose shall in no case be less than 1½ inches in internal diameter. The pumps for supplying the boilers shall in no case be considered as an equivalent for the double-acting steam fire pump on steamers above 50 gross tons. Every steamer exceeding 150 gross tons and not otherwise provided for shall be provided with one good double-acting fire pump, to be worked by hand: *Provided,* That when a steam pump is equipped to work by hand the same shall be accepted as a hand fire pump. Each chamber shall be of sufficient capacity, and the stroke so regulated, that not less than 100 cubic inches of water shall be displaced by each stroke of the piston. Each pump shall be placed in the most suitable part of the vessel for efficient service, having § 4471, R. S.

- (IV, 13) suitable, well-fitted hose to such pump long enough to reach to all parts of the vessel, kept at all times in perfect order, with brakes shipped up and hose coupled on ready for immediate use.

All steamers of over 20 gross tons, carrying passengers for hire, and all steamers of over 50 gross tons, not otherwise provided for, shall be provided with a steam fire pump, water pipes, and hose of same capacity and kind as those on passenger steamers, length of hose and pipes sufficient to throw a good volume of water to any portion of the steamer. Where pipe is used in lieu of hose proper, hose connections shall be located not more than 60 feet apart, and one such connection shall be located within 60 feet of either end of the ship, and shall be provided with not less than 50 feet of hose.

§ 4479, R. S.

All steamers of more than 20 tons, carrying passengers, including pleasure vessels, shall be provided with such number of good and efficient portable fire extinguishers, approved by the Board of Supervising Inspectors, as shall hereafter be prescribed, viz:

	Fire extinguishers.
Steamers from 20 to 50 tons	1
Steamers from 50 to 100 tons	2
Steamers from 100 to 500 tons	3
Steamers from 500 to 1,000 tons.....	6
Steamers over 1,000 tons, not less than	8

Freight and towing steamers of over 250 tons shall be provided with chemical fire extinguishers as hereafter prescribed, viz:

	Fire extinguishers.
Steamers from 250 to 500 tons	1
Steamers over 500 tons.....	2

The tables of required fire extinguishers in this section are based on the capacity of the ordinary machine, which is about 2½ gallons. Fire extinguishers of approved types of less capacity are allowable when their total contents equal the required quantity.

All chemical fire extinguishers thus provided for shall be able to withstand a pressure of 350 pounds to the square inch, except such fire extinguishers as have no stopcock or valve between the chamber and discharge, in which case they may be used after having been tested to 150 pounds pressure to the square inch.

Fire extinguishers shall be located in such parts of the vessels as in the judgment of the local inspectors will be most convenient and serviceable in case of emergency, and so arranged that they may be easily removed from their fastenings. Every fire extinguisher thus provided for shall be discharged and examined at each annual inspection. Portable hand pumps with an attached carrying capacity of 5 gallons of water may be substituted for the fire extinguishers above described.

§ 4471, R. S.

14. All steam fire pumps required shall be supplied with connecting pipes leading to the hold of the vessel

with stopcocks or shut-off valves attached and so arranged that such pumps may be used for pumping and discharging water overboard from the hold; and each compartment bulkhead shall be fitted with valves, so as to admit water from one compartment to the other, and the valves so arranged as to be worked from the main deck. (IV, 14)

Each and every steam vessel shall be fitted with a bilge pipe leading from each compartment of the vessel and connecting with a suitably marked valve to the main bilge pump in the engine room, and each compartment of all steam vessels shall be fitted with suitable sounding pipe. Steam siphons may be substituted in each compartment for the bilge pipes.

All hose required on steam vessels for fire purposes shall be tested to a pressure of 100 pounds to the square inch at each inspection, and it shall be the duty of the local inspectors at each annual inspection to see that the couplings are securely fastened to the hose by suitable external or internal clamps, and at least one length of such hose shall be kept at all times attached to each outlet of the fire main and provided with a suitable nozzle.

15. All pipes used as mains for conducting water from fire pumps on board steam vessels in place of hose shall be of wrought iron, brass, or copper, with wrought-iron, brass, or composition connections. § 4471, R. S.

16. Steam siphon pumps which have been approved by the Board of Supervising Inspectors may be allowed in lieu of double-acting steam fire pumps on all steamers of 100 gross tons and under. § 4471, R. S.

17. Wherever the words "passenger steamer," "steamer carrying passengers," or "vessel carrying passengers" occur in this entire rule (Rule IV), the said words shall be construed to mean and apply to only vessels carrying passengers for hire, and the words "carrying passengers" shall be construed to mean "carrying passengers for hire."

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LICENSES, HOW OBTAINED, AND PENALTIES RELATING THERE TO.

§ 4445, R. S.

1. Before an original license is issued to any person to act as a master, mate, pilot, or engineer, he must personally appear before some local board or a supervising inspector for examination; but upon the renewal of such license, when the distance from any local board or supervising inspector is such as to put the person holding the same to great inconvenience and expense to appear in per-

son, he may, upon taking oath of office before any person authorized to administer oaths, and forwarding the same, together with the license to be renewed, to the local board or supervising inspector of the district in which he resides or is employed, have the same renewed by the said inspectors, if no valid reason to the contrary be known to them; and they shall attach such oath to the stub end of the license which is to be retained on file in their office: *Provided, however,* That any officer holding a license, and who is engaged in a service which necessitates his continuous absence from the United States, may make application in writing for one renewal and transmit the same to the board of local inspectors with a statement of the applicant, verified before a consul or other officer of the United States authorized to administer an oath, setting forth the reasons for not appearing in person, and upon receiving the same the board of local inspectors that originally issued such license shall renew the same for one additional term of such license, and shall notify the applicant of such renewal. (V, 1)

The first license issued to any person by a United States inspector shall be considered an original license, where the United States records show no previous issue to such applicant.

No original license shall be issued to any naturalized citizen on less experience in any grade than would have been required of an American by birth.

2. All licenses hereafter issued to masters, mates, pilots, and engineers shall be filled out on the face with pen and black ink instead of typewritten. Inspectors are directed, when licenses are completed, to draw a broad pen and black-ink mark through all unused spaces in the body thereof, so as to prevent, as far as possible, illegal interpolation after issue. § 4405, R. S.

3. Licensed officers serving under five years' license, entitled by license and service to raise of grade, shall have issued to them new licenses for the grade for which they are qualified, the local inspectors to forward to the Supervising Inspector-General the old license when surrendered, with the report of the circumstances of the case. § 4405, R. S.

But the grade of no license shall be raised, except as hereinafter provided, unless the applicant can show one year's actual experience in the capacity for which he has been licensed.

4. In case of loss of license, of any class, from any cause, the inspectors, upon receiving satisfactory evidence of such loss, shall issue a certificate to the owner thereof, which shall have the authority of the lost license for the unexpired term, unless in the meantime the holder thereof shall have the grade of his license raised after due examination; in which case a license in due form for such grade may be issued. § 4405, R. S.

5. Inspectors shall, before granting an original license § 4405, R. S.

(V, 5) to any person to act as an officer of a vessel, require the applicant to make his written application upon the blank form authorized by the Board of Supervising Inspectors, which application shall be filed in the records of the inspectors' office. Inspectors shall also, when practicable, require applicants for pilot's license to have the written indorsement of the master and engineer of the vessel upon which he has served, and of one licensed pilot, as to his qualifications. In the case of applicants for original engineer's license, they shall also, when practicable, have the indorsement of the master and engineer of a vessel on which they have served, together with one other licensed engineer.

§ 4406, R. S. 6. No original master's, mate's, pilot's, or engineer's license shall be issued hereafter or grade increased except upon written examination, which written examination shall be placed on file as records of the office of the inspectors issuing said license; and, before granting or renewing a license, inspectors shall satisfy themselves that the applicants can properly hear the bell and whistle signals.

§ 4406, R. S. 7. Any applicant for license who has been duly examined and refused may come before any local board for reexamination after one year has expired.

§ 4406, R. S. 8. When any person makes application for license it shall be the duty of the local inspectors to give the applicant the required examination as soon as practicable.

§ 4445, R. S. 9. Any person who has served at least one year as master, commander, pilot, or engineer of any steam vessel of the United States in any service in which a license as master, mate, pilot, or engineer was not required at the time of such service, shall be entitled to license as master, mate, pilot, or engineer, if the inspectors, upon written examination, as required for applicants for original license, may find him qualified: *Provided*, That the experience of any such applicant within three years of making application has been such as to qualify him to serve in the capacity for which he makes application to be licensed.

Officers of the Naval Militia who are applicants for license as master or pilot of steam vessels of the Naval Militia, after passing an examination for color blindness, may be examined by the inspectors as to their knowledge of the pilot rules and handling of vessels; and if the applicant be found qualified, in the judgment of the inspectors, he may be granted a special license as master, mate, or pilot on such vessels on the waters of the district in which such license is granted, and for no other purpose.

Any officer of the Naval Militia who is an applicant for license as chief engineer or assistant engineer of steam vessels of the Naval Militia may be examined by inspectors and granted a special license as such, and for no other purpose, if, in the judgment of the inspectors, he is qualified. And the inspectors shall state on the license the name of the vessel on which such master, mate, pilot, or

engineer is authorized to act in the capacity for which he is licensed. (V, 9)

All licenses issued to officers of the Naval Militia provided for in the preceding paragraph of this section shall be surrendered upon the party holding it becoming disconnected from the Naval Militia by resignation or dismissal from such service; and no license shall be issued as above except upon the official recommendation of the chief officer in command of the Naval Militia station of the State in which the applicant is serving.

Masters, mates, engineers, and assistant engineers now serving as such on tenders and light-vessels under the jurisdiction of the Light-House Establishment may be granted special licenses for the Light-House Service upon satisfactory evidence of their fitness for such special license. Experience in the Light-House Service shall be sufficient to entitle applicants to this examination, and no other experience shall be required for such special license.

10. No person holding special license (Form 878) shall be eligible for examination for a higher grade of license until such person has actually served two full seasons under the authority of his license and one additional full season in a subordinate capacity upon steamers requiring regularly licensed officers. § 4405, R. S.

11. Whenever an officer shall apply for a renewal of his license for the same grade the presentation of the old certificate shall be considered sufficient evidence of his title to renewal, which certificate shall be retained by the inspectors upon their official files as the evidence upon which the license was renewed: *Provided*, That it is presented within twelve months after the date of its expiration, unless such title has been forfeited or facts shall have come to the knowledge of the inspectors which would render a renewal improper; nor shall any license be renewed in advance of the date of the expiration thereof, unless there are extraordinary circumstances that shall justify a renewal beforehand, in which case the reasons therefor must appear in detail upon the records of the inspectors renewing the license. § 4405, R. S.

12. When the license of any master, mate, pilot, or engineer is revoked such license expires with such revocation, and any license subsequently granted to such person shall be considered in the light of an original license. And upon the revocation or suspension of the license of any such officer said license shall be surrendered to the local inspectors ordering such suspension or revocation. § 4450, R. S.

13. The suspension or revocation of a joint license shall debar the person holding the same from the exercise of any of the privileges therein granted, so long as such suspension or revocation shall remain in force. § 4450, R. S.

14. When the license of any master, mate, engineer, or pilot is suspended, the inspectors making such suspension shall determine the term of its duration, except that such

(V, 14) suspension can not extend beyond the time for which the license was issued.

§§ 4439, 4442,
R. S.

15. It shall be the duty of all inspectors before renewing an existing license to a master or pilot of steam vessels for any waters, who has not been employed as master or pilot of steam vessels on such waters during the three years preceding the application for renewal, to satisfy themselves, by an examination in writing, or orally, to be taken down in writing by the inspectors, that such officers are thoroughly familiar with the pilot rules upon the waters for which they are licensed.

§ 4406, R. S.

16. Each master and pilot of steam vessels, wherever employed, shall, when receiving his license, either original or renewal, be furnished with a pamphlet copy of the rules and regulations governing pilots and of the statutes upon which such rules are founded, applicable to the waters on which their licenses are intended to be used, as stated in the body thereof.

§ 4442, R. S.

17. Inspectors are forbidden to issue original licenses to pilots who can not read and write: *Provided, however,* That upon navigable waters of the United States newly opened to steamboat navigation, and where the only pilots obtainable are illiterate Indians or other natives, the fact that such persons can neither read nor write shall not be considered a bar to such Indians or other natives receiving license as pilot of steam vessels, provided they are otherwise qualified therefor. Inspectors having jurisdiction over the Red River of the North and rivers whose waters flow into the Gulf of Mexico are forbidden to issue original licenses to pilots for routes extending beyond these rivers.

§ 4442, R. S.

18. Local inspectors having jurisdiction on the Atlantic coast, Pacific coast, or Gulf of Mexico may indorse any pilot's license for extension of route, subject to the approval of the adjoining boards having jurisdiction.

§ 4406, R. S.

19. Masters and pilots of steamers carrying passengers for hire shall exclude from the pilot houses and navigator's bridge of such steamers, while under way, all persons not connected with the navigation of such steamers, except officers of the Steamboat-Inspection Service and of the Revenue-Cutter Service when upon business: *Provided,* That licensed officers of steamboats, persons regularly engaged in learning the profession of pilot, officers of the United States Navy, United States Coast and Geodetic Survey, and Light-House Service, and engineer officers connected with the improvement of rivers and harbors may be allowed in the pilot house or upon the navigator's bridge upon the responsibility of the officer in charge.

The master of every such steamer shall keep three printed copies of this section of Rule V posted in conspicuous places on such steamer, one of which shall be kept posted in the pilot house.

Such printed copies shall be furnished by the Department of Commerce and Labor to local inspectors for distribution.

CLASSIFICATION OF ENGINEERS.

CHIEF.

20. Chief engineer of ocean steamers.

Chief engineer of condensing lake, bay, and sound steamers. § 4441, R. S. (V)

Chief engineer of noncondensing lake, bay, and sound steamers.

Chief engineer of condensing river steamers.

Chief engineer of noncondensing river steamers.

Any person holding chief engineer's license shall be permitted to act as first assistant on any steamer of double the tonnage of same class named in said chief's license.

Engineers of all classifications may be allowed to pursue their profession upon all waters of the United States in the class for which they are licensed.

FIRST ASSISTANT.

First assistant engineer of ocean steamers.

First assistant engineer of condensing lake, bay, and sound steamers.

First assistant engineer of noncondensing lake, bay, and sound steamers.

First assistant engineer of condensing river steamers.

First assistant engineer of noncondensing river steamers.

Engineers of lake, bay, and sound steamers, who have actually performed the duties of engineer for a period of three years, shall be entitled to examination for engineer of ocean steamers, applicant to be examined in the use of salt water, method employed in regulating the density of the water in boilers, the application of the hydrometer in determining the density of sea water, and the principle of constructing the instrument; and shall be granted such grade as the inspectors having jurisdiction on the Great Lakes and seaboard may find him competent to fill.

Any assistant engineer of steamers of 1,500 gross tons and over, having had actual service in that position for one year, may, if the local inspectors, in their judgment, deem it advisable, have his license indorsed to act as chief engineer on lake, bay, sound, or river steamers of 750 gross tons or under.

Any person having had a first assistant engineer's license for two years and having had two years' experience as second assistant engineer, shall be eligible for examination for chief engineer's license.

SECOND ASSISTANT.

Second assistant engineer of ocean steamers.

Second assistant engineer of condensing lake, bay, and sound steamers.

Second assistant engineer of noncondensing lake, bay, (V, 20)
and sound steamers.

Second assistant engineer of condensing river steamers.

Any person having had a second assistant engineer's license for two years, and having had two years' experience as third assistant engineer, shall be eligible for examination for first assistant engineer's license.

THIRD ASSISTANT.

Third assistant engineer of ocean steamers.

Third assistant engineer of condensing lake, bay, and sound steamers.

First, second, and third assistant engineers may act as such on any steamer of the grade of which they hold license, or as such assistant engineer on any steamer of a lower grade than those to which they hold a license.

Any person having a third assistant engineer's license for two years, and having had two years' experience as oiler or water tender since receiving said license, shall be eligible for examination for second assistant engineer's license.

Inspectors may designate upon the certificate of any chief or assistant engineer the tonnage of the vessel on which he may act.

Any assistant engineer may act as engineer in charge on steamers of 100 tons and under. In all cases where an assistant engineer is permitted to act as engineer in charge, the inspectors shall so state on the face of his certificate of license without further examination.

21. It shall be the duty of an engineer when he assumes charge of the boilers and machinery of a steamer to forthwith thoroughly examine the same, and if he finds any part thereof in bad condition, caused by neglect or inattention on the part of his predecessor, he shall immediately report the facts to the master, owner, or agent, and to the local inspectors of the district, who shall thereupon investigate the matter, and if the former engineer has been culpably derelict of his duty, they shall suspend or revoke his license. § 4441, R. S.

22. Before making general repairs to a boiler of a steam vessel the engineer in charge of such steamer shall report, in writing, the nature of such repairs to the local inspector of the district wherein such repairs are to be made. § 4441, R. S.

And it shall be the duty of all engineers when an accident occurs to the boilers or machinery in their charge tending to render the further use of such boilers or machinery unsafe until repairs are made, or when, by reason of ordinary wear, such boilers or machinery have become so unsafe, to report the same to the local inspectors immediately upon the arrival of the vessel at the first port reached subsequent to the accident, or after the discovery of such unsafe condition by said engineer.

23. Whenever a steamer meets with an accident involving loss of life or damage to property it shall be the duty of the licensed officers of any such steamer to report the same in writing and in person without delay to the nearest board: *Provided*, That when from distance it may be inconvenient to report in person it may be done in writing only and the report sworn to before any person authorized to administer oaths.

(V)
§ 4448, R. S.

24. No person shall receive an original license as engineer or assistant engineer (except for special license on small pleasure steamers and ferryboats of 10 tons and under, sawmill boats, pile drivers, boats exclusively engaged as fishing boats, and other similar small vessels) who has not served at least three years in the engineer's department of a steam vessel, a portion of which experience must have been obtained within the three years next preceding the application.

§ 4441, R. S.

Provided, That any person who has served three years as apprentice to the machinist trade in a marine, stationary, or locomotive engine works, and any person who has served for a period of not less than three years as a locomotive or stationary engineer, and any person graduated as a mechanical engineer from a duly recognized school of technology, may be licensed to serve as an engineer of steam vessels after having had not less than one year's experience in the engine department of steam vessels, a portion of which experience must have been obtained within the three years preceding his application; which fact must be verified by the certificate, in writing, of the licensed engineer or master under whom the applicant has served, said certificate to be filed with the application of the candidate; and no person shall receive license as above, except for special license, who is not able to determine the weight necessary to be placed on the lever of a safety valve (the diameter of valve, length of lever, distance from center of valve to fulcrum, weight of lever, and weight of valve and stem being known) to withstand any given pressure of steam in a boiler, or who is not able to figure and determine the strain brought on the braces of a boiler with a given pressure of steam, the position and distance apart of braces being known, such knowledge to be determined by an examination in writing, and the report of examination filed with the application in the office of the local inspectors, and no engineer or assistant engineer now holding a license shall have the grade of the same raised without possessing the above qualifications. No original license shall be granted any engineer or assistant engineer who can not read and write and does not understand the plain rules of arithmetic.

25. Any person may be licensed as engineer (on Form 2130½) [New Form 880] on vessels propelled by gas, fluid, naphtha, or electric motors, of 15 gross tons or over, engaged in commerce, if in the judgment of the inspectors,

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(V, 25) after due examination in writing, he be found duly qualified to take charge of the machinery of vessels so propelled.

Any person holding a license as engineer of steam vessels, desiring to act as engineer of motor vessels, must appear before a board of local inspectors for examination as to his knowledge of the machinery of such motor vessels, and if found qualified shall be licensed as engineer of motor vessels. Form 878, special license to engineers, shall be issued only to engineers in charge of vessels of 10 tons and under. All other licenses to engineers shall be issued on Forms 876 and 877, according to grades specified in this section.

MASTERS OF STEAM VESSELS.

No original license as master of any steam vessel shall be issued, except under the conditions hereinafter provided:

MASTERS OF OCEAN STEAM VESSELS.

§ 4439, R. S.

26. Any applicant for license as master of ocean steamers must furnish satisfactory documentary evidence to the local inspectors that he has had three years' experience on ocean steamers, one year of which has been as chief mate, or five years' experience on ocean sail vessels of 300 gross tons and upward, two years of which must have been as a licensed master of sail vessels; and he must understand navigation and be able to determine the ship's position at sea by observation of the sun, to obtain longitude by chronometer, and to determine ship's latitude by the altitude of either the sun, moon, or stars. The examination to determine his qualifications shall be in writing, which shall be kept on file in the office of the inspectors granting the license.

It is further provided, That where any person has actually served as a licensed third officer of ocean steamers of 3,500 gross tons and upward for five years, he shall be eligible for examination for license as master of ocean steamers.

Any person who has had three years' actual experience as master of steam vessels of 1,000 gross tons and upward on the Great Lakes and can produce documentary evidence of the fact may be examined for license as chief mate of ocean steamers, and after having had one year's actual experience as chief mate of ocean steamers of 1,000 gross tons and upward, may be examined for license as master of ocean steamers, the examination to be the same as that provided for in the first paragraph of this section.

MASTERS OF LAKE, BAY, AND SOUND STEAMERS.

§ 4439, R. S.

27. No original license as master of lake, bay, and sound steamers shall be issued hereafter to any person who has not been licensed and served at least one year as first-class

pilot or chief mate on such steamers, such service as pilot or chief mate to have been within the three years next preceding the application for license. (V, 27)

Provided, however, That any person who has served three years as master of sail vessels on the Great Lakes shall be eligible for examination for master's license of steam vessels on the Great Lakes and other inland waters.

It is further provided, That masters of barge consorts on the Great Lakes having had three years' actual experience as such, who have been licensed as first-class pilots for one year or more, may be examined and licensed as masters of steam vessels on the Great Lakes and other inland waters, if found qualified.

Whenever a master or mate desires to act in the double capacity of master and pilot, or mate and pilot, and furnishes the necessary evidence of his qualifications, the local inspectors shall indorse such pilot routes on the certificate of license.

MASTERS OF COASTWISE STEAMERS.

28. Any person holding a license as master of lake, bay, and sound steamers may have indorsed thereon the authority allowing him to act as master of steamers upon the waters of the Atlantic coast and the Gulf of Mexico: *Provided,* That the applicant has had at least one year's experience as mate, quartermaster, or wheelsman of steam vessels upon the waters of the Atlantic coast or the Gulf of Mexico, which experience must have been obtained within the three years preceding his application for such indorsement, and the fact must be verified by satisfactory documentary evidence to be filed in the office of the local inspectors; and the applicant shall only be subjected to such examination in writing as shall satisfy the local inspectors that he is capable of navigating such steamers. Inspectors shall state in the indorsement on the license the coastwise waters that the applicant is qualified to act upon as master. Practical service in the deck department of an ocean-going or coastwise steam yacht shall be accepted, when offered in documentary evidence by any person applying for an original license or raise of grade on ocean-going or coastwise steam vessels, as being equal to the same amount of service in any ocean-going or coastwise steam passenger vessel. § 4439, R. S.

MASTERS OF RIVER STEAMERS.

29. Inspectors shall examine all applicants for original license as master of steamers navigating rivers exclusively, which examination shall be reduced to writing and made a part of the permanent records of the office of the inspectors making such examination; and no original license shall be issued to any person to act as master of such steamers who has not, by actual service on board of such steamers for a period of not less than three years, acquired practical knowledge, skill, and experience essential in case § 4439, R. S.

- (V, 29) of emergency and disaster, and in the navigation of such steamers with safety to life and property, and at least one year of service to have been within the three years next preceding the application, and such license shall entitle the holder of the same to act as master on any river steamer of the United States, and no license as master shall be issued to any applicant who can not read and write, and who has not served at least one year as licensed mate or pilot of steam vessels.

The line of examination to be pursued by inspectors in examining applicants for original license as master of river steamers shall be as follows:

(1) As to his general knowledge of the duties of master of such steamers.

(2) As to his ability to handle the wheel in case of emergency or disaster.

(3) As to the knowledge of his duties and proper method of procedure in case of fire on his vessel.

(4) As to his knowledge of proper management of vessel and crew in case of collision and sinking.

(5) As to executive ability generally to manage officers and crew.

(6) As to his general knowledge and ability to navigate steamers with safety to life and property.

(7) As to his knowledge of pilot rules governing the navigation of such steamers.

(8) As to his knowledge of signals between the pilot house and engine room.

(9) As to his knowledge of signal lights and their proper position on all steam and other vessels.

(10) As to duties of master in case of fog or stormy weather, and on such other subjects in connection with the navigation of such vessels as the inspectors conducting such examination may deem proper and necessary.

MASTERS OF SAIL VESSELS.

Local inspectors may, upon due application and examination, license any person as master of sail vessels of 700 gross tons and upward, or of sail vessels of any tonnage carrying passengers for hire, upon receipt of satisfactory documentary evidence, to be filed in their office, that said person has been actually employed as master of sail vessels of 200 gross tons and upward or as chief mate of sail vessels of 700 gross tons and upward for the full period of twelve months next preceding the application.

MATES OF SAIL VESSELS.

Local inspectors may, upon due application and examination, license any person as chief mate of sail vessels of 700 gross tons and upward, upon receipt of satisfactory documentary evidence, to be filed in their office, that said person has been actually employed as chief mate of sailing

vessels of 200 gross tons for one year, or as second mate on vessels of 200 gross tons for a period of two years next preceding the application. (V, 29)

The examination for license as master or mate of sail vessels of 700 gross tons and upward shall be the same as required for masters and mates of steam vessels.

30. Whenever the owner of steam or sailing yachts, who has had three years' experience on board such yachts, applies for license to act as pilot of steam yachts, the local inspectors shall examine the applicant, in writing, in regard to his knowledge in handling such vessels, and familiarity with the lights, light-houses, channels, buoys, obstructions, courses, and distances between certain points in the waters within the local inspection district in which the applicant is examined; and shall also examine him as to his knowledge of the pilot rules for inland waters, the running and anchor lights, fog signals, the use of the lead line, signal bells between the engine room and pilot house, and the general rules and regulations for steam vessels. If the local inspectors are satisfied, after such examination, of the applicant's ability, a pilot's license for steam yachts may be issued to him for the waters covered by the local inspection district in which said license is issued, which license may be indorsed to include the inland waters of other local inspection districts, by the local inspectors thereof, if satisfied, after examination, that the applicant is qualified therefor. § 4439, R. S.

Whenever the owner of a steam or sailing yacht of over 100 gross tons, who has had three years' experience in sailing such vessels, applies for a license authorizing him to act as master of steam yachts for coastwise and ocean navigation, the local inspectors shall examine the applicant as to his knowledge of the rules of the road, fog signals, signal lights—inland and international; the use of the lead and line, the use of the patent and chip logs, the compass, variation and deviation of the compass, the use of the drag, the use of oil during storms, bell signals between pilot house and engine room, handling of steam vessels, laws of storms, course and distance by chart, keeping the log book, middle latitude sailing, Mercator's sailing, method of obtaining latitude and longitude by dead reckoning, latitude by altitude of either the sun, moon, or stars; longitude by chronometer (time sights). Practical problems will be given in the subjects of latitude and longitude. The examination shall be in writing, which shall be kept on file in the office of the local inspectors. If said examination is satisfactory to the local inspectors, they shall issue to the applicant a master's license authorizing him to discharge the duties of master of steam yachts, either for coastwise or ocean navigation.

31. Any person navigating a pleasure yacht of 15 gross tons and under, for pleasure only, holding a master's or pilot's license, is fully authorized to navigate such pleasure yacht in the inland waters of the United States without § 4405, R. S.

(V, 31) being required to report to the various boards of inspectors whose districts they may be passing through.

§§ 4439, 4440,
R. S.

32. Any applicant for original license to act as master or mate of steam pilot boats, or of steamers navigating the waters of the whaling grounds in the Alaskan seas, or of steamers engaged exclusively in the business of whale fishing, or of steamers engaged in the Atlantic, Pacific, or Gulf coast fisheries, or of steam or sail vessels navigating between ports of the Hawaiian Islands, or between ports of the island of Porto Rico, must have had at least three years' experience in the deck department of such steamers, which fact must be verified by documentary evidence; and such applicant shall only be subjected to such examination as shall satisfy the inspectors that the applicant is capable of navigating such vessels: *It is provided*, That any person who has had at least five years' experience on sail vessels licensed in the fisheries of the United States, two years of which have been as master or mate of such sailing vessels, may be examined for license as master or mate of steam fishing vessels to be employed exclusively in the Atlantic, Pacific, and Gulf coast fisheries. The license issued under this section shall state in the body thereof "for coastwise only," Pacific or Atlantic coast, as the case may be, and between what ports on either of said coasts.

It is further provided, That said master's or mate's license may be indorsed as pilot on such inland waters on the above-named coasts as the local inspectors at the various ports may find the holder qualified to act on as pilot, after examination by the local inspectors, such examination to be in writing and preserved in the files of the inspectors' office.

MASTERS OF PASSENGER BARGES.

§ 4439, R. S.

33. Any person applying for license as master of barges carrying passengers for hire must have had three years' experience in the deck department of such vessels, and shall be subjected to such examination as will show his ability to handle the class of vessels for which he desires a license.

CHIEF MATE OF OCEAN STEAMERS.

§ 4440, R. S.

34. No original license as chief mate of ocean steamers shall be issued to any person who has not served at least three years in the deck department of such steam vessels, one year of such service to have been as second mate of such vessels.

Provided, That any person who has had five years' experience on sail vessels of 300 gross tons and over, two years of which have been in the capacity of chief mate of sail vessels of 700 gross tons and over, may be licensed as chief mate of ocean steamers.

It is further provided, That any person holding a license as chief mate, who has had two years' service in the capac-

ity of second mate, or watch officer actually in charge of a bridge watch since receiving such license as chief mate, shall be entitled to examination for master's license. (V, 34)

SECOND MATE OF OCEAN STEAMERS.

35. No original license for second mate of ocean steamers shall be issued to any person hereafter who has not had three years' experience on such steam vessels, two years of which shall have been as watch officer or quartermaster, or he must have had three years' experience on ocean sail vessels of 300 gross tons and over, one year of which shall have been as second mate of such sail vessels of 700 gross tons and upward: *Provided*, That any person holding a second mate's license who has had two years' experience on the same as watch officer shall be entitled to an examination for chief mate's license. § 4440, R. S.

THIRD MATE OF OCEAN STEAMERS.

36. No person shall receive an original license as third mate of ocean steamers who has not had three years' experience on ocean or coastwise steam vessels or sail vessels of 300 gross tons and upward as cadet or able seaman: *Provided*, That any person holding a license as third mate who has had two years' experience on said license as quartermaster on vessels of 2,500 gross tons and over shall be entitled to examination for second mate's license. § 4440, R. S.

37. No original license as chief mate of ocean steamers, as second mate of ocean steamers, or as third mate of ocean steamers shall be issued to any person who does not understand navigation and who is not able to determine a ship's position at sea by observation of the sun, to obtain longitude by chronometer, and to determine ship's latitude by altitude of either the sun, moon, or stars; said examination to be in writing and to be kept on file in the office of the local inspectors issuing the license. § 4440, R. S.

SECOND MATE OF OCEAN AND COASTWISE STEAMERS OF 500 TONS AND UNDER.

38. Any first-class seaman who has had three years' experience on the deck of a sail vessel and one year's experience in the deck department of a steam vessel shall be eligible for an examination for license as second mate of ocean and coastwise steamers of 500 gross tons and under. § 4440, R. S.

MATES OF COASTWISE STEAMERS.

39. Any person who has been licensed as second mate of ocean steamers, having had one year's experience as such, may have his license indorsed to act as chief mate of coastwise steamers without further examination. § 4440, R. S.

- (V, 39) Any person holding a license as first-class pilot of lake, bay, or sound steamers may have his license indorsed to act as chief mate of coastwise steamers. Any person who has had three years' experience in the deck department of a steam vessel shall be eligible for examination for license as chief mate of coastwise steamers upon the waters of the Atlantic coast, Pacific coast, and the Gulf of Mexico: *Provided*, That the applicant has had at least one year's experience as mate, quartermaster, or wheelsman of steam vessels upon the waters of the Atlantic coast, Pacific coast, or the Gulf of Mexico, which experience must have been obtained within three years preceding his application for such indorsement, and this fact must be verified by satisfactory documentary evidence to be filed in the office of the local inspectors; and the applicant shall only be subjected to such examination, in writing, as shall satisfy the local inspectors that he is capable of navigating the steamer. Inspectors shall state in the indorsement on the license the coastwise waters that the applicant is qualified to act upon as chief mate.

MATES OF INLAND OR RIVER STEAMERS.

- § 4440, R. S. 40. Whenever any person presents himself for examination for license as mate of inland or river steamers the local inspectors shall examine him as to his knowledge, experience, and skill in loading cargo and in handling and stowage of freight, his knowledge of the operation and handling of fire apparatus, the launching and handling of lifeboats, his knowledge of life-preservers and the method of adjusting them, his ability to manage the crew and direct and advise the passengers in case of emergency, and his general familiarity with his duties in maintaining discipline and protecting the passengers, and if found qualified they shall grant him a license as such, but no such license shall be granted to any person who has not had at least two years' experience in the deck department of a steam vessel.

FIRST-CLASS PILOTS.

- § 4442, R. S. 41. No original license as first-class pilot shall be issued to any person hereafter who has not had three years' experience in the deck department of a steam vessel, sail vessel, or barge consort: *Provided*, That on the Mississippi and tributary rivers one year of such required experience must have been in the pilot house as steersman.

SECOND-CLASS AND SPECIAL PILOTS.

- § 4412, R. S. 42. No original license as second-class pilot shall be issued to any person who has not had three years' experience in the deck department of a steam vessel, sail vessel, or barge consort: *Provided*, That on the Mississippi and

tributary rivers one year of such required experience must have been in the pilot house as steersman. (V, 42)

43. The navigation of every steamer above 100 gross tons shall be under the control of a first-class pilot, and every such pilot shall be limited in his license to the particular service for which he is adapted. Special pilots may also be licensed for steamers of 10 gross tons and under, locally employed. § 4442, R. S.

44. A second-class pilot may be allowed to take charge of a steamer not exceeding 100 gross tons. He may be authorized by the indorsement of the local inspectors granting the license to act in charge of a watch on any steamer. § 4442, R. S.

45. All passenger and ferry steamers shall, in addition to the regular pilot on watch, have one of the crew also on watch, in or near the pilot house; and this rule applies to all steamers navigating in the nighttime. § 4426, R. S.

46. No original license for pilot of any route shall be issued to any person, except for special license for steamers of 10 gross tons and under, who has not served at least three years in the deck department of a steamer, sail vessel, or barge consort, one year of which experience must have been obtained within the three years next preceding the date of application for license, which fact the inspectors may require, when practicable, to be verified by the certificate, in writing, of the licensed master or pilot under whom the applicant has served, such certificate to be filed with the application of the candidate. § 4442, R. S.

47. Pilots of steam vessels, while in the discharge of their duties, must be governed by the rules of the Board of Supervising Inspectors, made for their guidance, and not by any instructions emanating from any inspector or other person. §§ 4405, 4442, R. S.

48. Whenever any pilot applies to a board of local inspectors for an extension of his pilot's route, he shall make written application, by letter, stating the extension desired, and he shall be examined, in writing, on the aids to navigation on said extension, and, if found qualified, shall receive such extension. § 4405, R. S.

49. No original license as master, mate, or pilot of any vessel propelled in whole or in part by steam, gas, fluid, naphtha, alco-vapor, electric, or other like motors, or master or mate of sail vessels, shall be granted except on the official certificate of a surgeon of the Public Health and Marine-Hospital Service that the applicant is free from the defect known as color blindness. No renewal of license shall be granted to any officer of the classes named who has not been previously examined and passed for color blindness. §§ 4439, 4440, 4442, R. S.

Any person requiring examination for color blindness, who is living at a distance of 100 miles or more from a surgeon of the Public Health and Marine-Hospital Service, may be examined for color blindness by any reputable physician; and the physician shall furnish a duplicate report

of the examination made upon the regulation blanks, one copy of which shall be furnished the applicant and the other sent to the local inspectors of steam vessels to whom the applicant shall apply for such original or renewal of license. (V, 49)

50. It shall be the duty of the officer in charge of every steamer carrying passengers to cause to be prepared a station bill for his own department, and one also for the engineer's department, in which shall be assigned a post or station of duty for every person employed on board such steamer in case of fire or other disaster; which station bills shall be placed in the most conspicuous places on board for the observation of the crew. And it shall be the duty of such master, or of the mate or officer next in command, once at least in each week, to call all hands to quarters and exercise them in the discipline, and in the unlashing and swinging out of the lifeboats, weather permitting, and in the use of the fire pumps and all other apparatus for the safety of life on board of such vessel, with especial regard for the drill of the crew in the method of adjusting life-preservers and educating passengers and others in this procedure, and to see that all the equipments required by law are in complete working order for immediate use; and the fact of the exercise of the crew, as herein contemplated, shall be entered upon the steamer's log book, stating the day of the month and hour when so exercised; and it shall be the duty of the inspectors to require the officers and crew of all such vessels to perform the aforesaid drills and discipline in the presence of the said inspectors at intervals sufficiently frequent to assure the said inspectors by actual observation that the foregoing requirements of this section are complied with; the master shall also report monthly to the local inspectors the day and date of such exercise and drill, the condition of the vessel and her equipment, and also the number of passengers carried, and any neglect or omission on the part of the officer in command of such steamer to strictly enforce this rule shall be deemed cause for the suspension or revocation of the license of such officer. Three copies of this section shall be furnished every steamer carrying passengers, to be framed under glass and posted in conspicuous places about the vessel. § 4405, R. E

51. It shall be the duty of the mate of every inland or river steamer carrying passengers to assign to deck or steerage passengers the space they may occupy on board during the voyage, and to supervise the stowage of freight or cargo, and see that the space set apart for passengers is not encroached upon. He shall also carefully examine all packages of freight delivered on board for shipment, with a view to detect and prevent any combustible or other dangerous articles prohibited by law being delivered on board. Three copies of this section shall be furnished every steamer to which this section applies, to be framed under glass and § 4440, R. E

posted in conspicuous places about the steamer, one of (V, 51)
which shall be on the main deck.

RULE VI.—INSPECTION OF STEAMERS.

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Permit to proceed to other ports for repairs, how issued.....	7
Steamers, inspectors may lawfully inspect.....	3

1. The annual inspection of any vessel subject to the provisions of Title LII, Revised Statutes of the United States, must be made only on written application, presented to the United States local inspectors by the owner, master, or authorized agent of the vessel to be inspected. Such application must state upon its face that previous application for inspection has not been made to any other board of local inspectors or supervising inspector. § 4417, R. S.

2. Steam vessels employed by the Government, unless the titles of the same are actually vested in the United States, are not exempt from inspection. § 4400, R. S.

3. Inspectors may lawfully inspect within their respective districts, upon proper application, any vessel running upon the waters of their district the certificate of which is about to expire. § 4417, R. S.

4. In the inspection of the hulls of vessels, if the inspector shall not have satisfactory evidence otherwise of the soundness of the timber, he shall not give a certificate until the hull of the vessel shall be bored to his satisfaction. § 4417, R. S.

5. Whenever any vessel is placed upon the dock for repairs it shall be the duty of the master, owner, or agent to report the same to the board of local inspectors of that district, so that a thorough inspection may by them be made to determine what is necessary to make such vessel seaworthy if the condition or age of the vessel, in the judgment of the inspectors, renders such examination necessary. § 4417, R. S.

6. Certificates of inspection signed by one local inspector only shall not be valid, nor shall the name of a regular inspector be substituted by that of any other person upon any such certificate. This rule also applies to licenses. § 4421, R. S.

7. Certificates of inspection for any period less than one year shall not be issued, but nothing herein shall be construed as preventing the revocation or suspension of certificates of inspection, in case the same be allowed by law, or from preventing local inspectors from inspecting vessels for renewal of certificate, upon due application in

(VI, 7) writing, at any time not exceeding sixty days of expiration of current certificate of inspection, providing the same can be done without greater expense than would be incurred if taking place when inspection is regularly due, and that such inspection shall not interfere with other inspections regularly falling due at the same time. This rule, however, is not to be construed as preventing the inspection of any vessel at an earlier period than sixty days anterior to the expiration of the vessel's certificate, when such vessel has been practically rebuilt, or when necessary "for the purpose of concentrating the work of the inspectors within certain given periods" (Department decision 7703, Aug. 17, 1886, p. 216, Manual, edition 1890), for the purpose of saving traveling expenses.

Local inspectors issuing a permit to any vessel to proceed to other ports for repairs must state upon the face of the same the conditions upon which it is granted and whether the vessel is to be allowed to carry freight or passengers, the quantity and number: *Provided, however*, That no vessel whose certificate has *expired* will be permitted to carry passengers or freight while en route to another port for repairs.

When, under section 4456, Revised Statutes of the United States, vessels obtain a permit from the local inspectors of a district to go from their district to another to make repairs, said local inspectors shall notify the supervising inspector of their district, stating the repairs to be made on said vessels. The supervising inspector shall notify the supervising inspector of the district where such repairs are to be made, furnishing him a copy of the report of the inspectors indicating the repairs ordered on said vessels.

RULE VII.—FERRYBOATS.

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§ 4233, R. S.

1. All double-end ferryboats on lakes and seaboard shall carry a central range of clear, bright, white lights, showing all around the horizon, placed at equal altitudes forward and aft; also such side lights as specified in paragraphs (b) and (c), article 2, act of Congress approved June 7, 1897. Local inspectors in districts having ferryboats shall, whenever the safety of navigation may require, designate for each line of such boats a certain light, white

or colored, which shall show all around the horizon, to designate and distinguish such lines from each other, which lights shall be carried on a flagstaff amidships, 15 feet above the white range lights. The signal lights on ferryboats on waters flowing into the Gulf of Mexico and their tributaries shall be the same as those on all other steamboats on the same waters, except double-end ferryboats, which shall be governed by the rule governing double-end ferryboats on lakes and seaboard. (VII, 1)

2. Steam vessels employed as a means of crossing any river, or other similar water, in continuation of any established highway, shall be considered ferryboats under the law, and the navigation of such vessels must be confined to the ferry routes specified in the inspection certificate issued; but such vessels may be permitted, under excursion permits, to go beyond their authorized routes with passengers only, or without such permit, to lighten or relieve vessels in distress. § 4426, R. S.

3. All steam ferryboats whose construction was commenced after June 30, 1905, carrying passengers for hire, and navigating bays, sounds, or rivers, shall be supplied with a sufficient number of water-tight bulkheads to float the vessel if the largest compartment is filled with water. § 4426, R. S.

4. All ferryboats of 50 gross tons or over shall be equipped with such lifeboats, life rafts, outside ladders, and other means of escape, in case of disaster, as, in the opinion of the inspectors, shall meet the requirements of each particular case. But in no case shall the cubic feet of boat capacity be less than that provided in the following table:

	Cubic feet.
Ferryboats of 50 and not over 300 gross tons.....	120
Ferryboats over 300 and not over 600 gross tons.....	240
Ferryboats over 600 gross tons.....	360

Provided, That on ferryboats of more than 300 gross tons, one-half the boat capacity required may be substituted by its equivalent in approved life rafts.

Ferryboats of less than 50 gross tons shall be equipped with boats or rafts as in the opinion of the inspectors may be necessary in case of disaster to secure the safety of all persons on board.

5. All ferryboats shall be equipped with a life-preserver (or float where the same is allowed by law) for every 7 square feet of passenger deck surface on single-deck ferryboats and for every 12 square feet of such deck surface on ferryboats having more than one passenger deck, and such life-preservers or floats shall be distributed in the most accessible places, where they can be reached at all times, and it shall be the duty of the local inspectors to see that all the life-preservers or floats are marked with the name of the vessel having the same on board. § 4426, R. S.

All ferryboats shall be provided with the same fire apparatus required on passenger steamers of equal tonnage.

(VII)
§ 4492, R. S.

6. All barges in tow of steamers used for transferring persons on any lake, bay, sound, or river shall be provided with the same life-saving appliances as required for passenger steamers.

All towed barges used for transferring railroad passenger cars on any lake, bay, sound, or river, with passengers in cars, shall be required to have the same life-saving appliances as required by section 22 of Rule III.

All car ferry steamers engaged in transferring passenger cars, with passengers in cars, shall be equipped as ferryboats, excepting that the number of life-preservers required shall equal the number of persons carried: *Provided*, That where wooden life floats are allowed by law they may be used instead of life-preservers.

It shall be the duty of the master of any such barge or steamer to see that all of the doors of the cars are unlocked and vestibules of the cars are open while the same are on the barge or steamer to allow the persons so carried free egress at all times.

RULE VIII.—EXCURSION STEAMERS AND BARGES.

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§ 4466, R. S.

1. If the master, agent, or owner of any passenger or ferry steamer desires a permit to engage in excursions, the inspectors, upon the written application of such master, agent, or owner, which application must be accompanied by an affidavit that the proper equipment is on board, may issue the same, stating the number of extra passengers the boat may carry with safety, the route she may run, and the kind and extra number of life-saving appliances with which she is provided. The permit, when used, must be framed under glass and exposed to the view of the passengers, in connection with the certificate of inspection.

§ 4466, R. S.

2. Passenger steamers making excursions on the Northern and Northwestern lakes, bays, or rivers, or on waters of the Atlantic and Pacific coasts and rivers flowing into the same, and rivers whose waters flow into the Gulf of Mexico, shall have, in addition to their regular life-saving equipments, a life-preserver (or float where the same is allowed by law), made in accordance with the rules of the Board, or their equivalent in other approved life-saving appliances, for each additional passenger allowed.

§ 4466, R. S.

3. Steamers making excursions under a permit must have at least one lifeboat or life raft, in addition to the equipment required by the tables, so carried as to best secure the safety of those on board in case of disaster.

All barges carrying excursions under permit and in tow shall be required to carry a master, and shall also

carry not less than two competent men in deck crew for each 500 persons or fraction thereof carried on the barge. (VIII, 3) .

4. Every barge carrying passengers in tow and engaged in excursions shall be supplied with one life-preserver or one float for each passenger carried, and must have ten buckets, three axes, and two yawl boats of not less than 100 cubic feet capacity each, one of which boats must be manned and towed in such manner as to best afford prompt relief and assistance in case of accident or disaster. § 4492, R. S.

Steamers or barges carrying passengers on excursions must have their extra life-saving appliances and equipments plainly marked with the vessel's name, and must have the life-preservers and floats so distributed before leaving the wharf or dock as to be at all times within easy reach of the persons carried.

5. When any ferryboat leaves her ferry route to engage in excursions she shall be required to carry the same officers, crew, and equipment as required by other excursion steamers. § 4426, R. S.

RULE IX.—DUTIES OF INSPECTORS.

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1. Each supervising inspector, in his annual report to the Board of Supervising Inspectors, is required to report the number of steamers inspected in his district, classified and alphabetically arranged, stating when built, where built, amount of tonnage, the number of masters, mates, pilots, and engineers licensed, with their grade, number of issue, number of licenses; these lists to be made on blanks to be furnished by the Department. He is also required to report all expenditures in his district, includ-

§ 4410, R. S.

- (IX, 1) ing salaries, and traveling and incidental expenses; he is also required to report all casualties, such report to be made so as to accord in form with the tabular statement published in the nineteenth annual report; also any occurrence and matters which, in his opinion, will add value to the service and interest to the report.
- § 4410, R. S. 2. No supervising inspector shall make his annual report public until after the same has been presented to the Board of Supervising Inspectors, as required by section 4410, Revised Statutes; and, further, no local board, or the clerk thereof, shall make public any report without the consent of their supervising inspector or that of the Supervising Inspector-General.
- § 4411, R. S. 3. It shall be the duty of the supervising inspectors to inform their respective local boards, in writing, of their decisions in cases of appeal. Supervising inspectors granting license to a vessel engaged in towing to carry persons in addition to its crew, under the act approved July 9, 1886, shall notify the local inspectors in whose jurisdiction the steamer receiving the permit is engaged, and the local inspectors shall keep a record of the same.
- It shall be the duty of local inspectors to notify the local inspectors of adjoining districts, through the supervising inspector, of all revocations or suspensions of licenses, and also of the names of all persons from whom licenses have been withheld, the names of all steam vessels neglecting or refusing to make repairs when ordered, and the names of all that have been refused certificates, with the reasons therefor; and once in each year local inspectors shall be supplied with a list of all licensed officers, which shall be printed in the annual report of the supervising inspectors.
- § 4410, R. S. 4. It shall be the duty of local inspectors to report correctly at the end of the year, to the supervising inspectors, the number of boilers inspected in each of their local districts.
- § 4405, R. S. 5. Whenever any inspector shall find it necessary, in conducting his investigations or in the performance of any of his duties, to obtain testimony from the inspectors of other districts, he shall request the same through the supervising inspector.
- § 4405, R. S. 6. Local inspectors, at their annual inspections of steam boilers, shall remove from the surface of such boilers as are covered so much of said covering as may be necessary to enable them to examine parts of the boilers which can not be properly examined from the inside, and shall examine in a thorough and careful manner, when practicable, either externally or internally, all parts of the shell of every boiler; and the masters, engineers, and owners of every steam vessel shall afford every facility necessary to carry out in the most effective and efficient manner the provisions of this section, and in no case shall an intermediate inspection be deemed any part of the regular annual inspection.

7. It shall be the duty of local inspectors of boilers to thoroughly examine the interior of all boilers when it is practicable to do so, to see that the braces are in place and of proper size, and to determine whether the boilers are in good condition, before granting a certificate of inspection, such examinations to be made after the hydrostatic pressure has been applied. (IX) §§ 4405, 4417, 4418, R. S.

8. It shall also be the duty of the inspectors to compel all floating structures, such as steam elevators (propelled by their own motive power), to have their whistles located on the front side of such superstructures having an elevation higher than the pilot house of the vessels. § 4405, R. S.

9. All steam whistles shall be placed not less than 6 feet above the top of the pilot house of steam vessels where the height of the smokestack will admit the attachment of same below its top, when not hinged for passing under bridges, except upon steamers navigating the Red River of the North, and rivers whose waters flow into the Gulf of Mexico, and steamers of less than 100 gross tons, whose steam whistles shall be placed not less than 2 feet above the tops of their pilot houses, and all double-end ferry steamers, and steamers similarly constructed, shall have a steam whistle both fore and aft of the smoke pipe, so that the steam, when whistle is blown, can be seen from either end of steamer; and it shall be the duty of inspectors to enforce this rule at the annual inspection.

10. It shall be the duty of both the hull and boiler inspectors to be present when the boiler is being tested by hydrostatic pressure, and the hull inspector, as well as the boiler inspector, shall observe and note the indication upon the gauge. §§ 4405, 4417, 4418, R. S.

It shall also be the duty of both the hull and boiler inspectors to examine all pumps, hose, and other fire apparatus and to see that the hose is subjected to a pressure of 100 pounds to the square inch and that the hose couplings are securely fastened in accordance with these rules.

It shall be the duty of all local inspectors to require all ocean steamers of 500 gross tons and upward to be equipped with an efficient deep-sea sounding apparatus, in addition to the ordinary deep-sea hand lead.

11. Local boards shall report forthwith to their supervising inspectors in detail all accidents of a serious character—such as collisions, foundering, sinkings, fires—and all other casualties of interest to or affecting the steamboat service in their respective districts. § 4405, R. S.

12. Local boards shall report quarterly to their supervising inspectors all cases of revocation, suspension, and refusal of licenses to masters, mates, pilots, and engineers, with the reasons therefor; all examinations into alleged violations of the steamboat law, with their decisions thereon; steamers inspected, with their class and tonnage; steamers refused inspection, their class and tonnage, and the reasons for such refusal; steamers gone out of service, with their class and tonnage; the number of masters, mates,

- (IX, 12) pilots, and engineers licensed; grade of licenses issued during the quarters ending March 31, June 30, September 30, and December 31 of each year.

The quarterly reports shall be made on or immediately after the 5th day of January, April, July, and October in each year.

§ 4411, R. S.

13. Inspectors shall, on or before the 5th day of January in each year, make alphabetical lists, arranged according to class and grade, of names of vessels inspected during the year previous, with their tonnage, when and where built, the name and grade of masters, mates, pilots, and engineers licensed, together with all the events affecting the Steamboat-Inspection Service and occurring in their districts, and said facts shall be reported in a tabular form and according to blanks to be furnished by the Department of Commerce and Labor.

§§ 4418, 4436,
4437, R. S.

14. When it is known or comes to the knowledge of the local inspectors that any steam vessel is or has been carrying an excess of steam beyond that which is allowed by her certificate of inspection, the local inspectors in whose district said steamer is being navigated, in addition to reporting the fact to the United States district attorney for prosecution under section 4437, Revised Statutes of the United States, shall require the owner or owners of said steamer to place on the boiler of said steamer a lockup safety valve that will prevent the carrying of an excess of steam and shall be under the control of said local inspectors.

On the placing of a lockup safety valve upon any boiler, it shall be the duty of the engineer in charge of same to blow or cause the said valve to blow off steam at least once in each watch of six hours or less, to determine whether the valve is in working order, and it shall be the duty of the master of such vessel to see that this rule is observed, and it shall be the duty of the master and engineer to report to the local inspectors any failure of such valve to operate.

In case no such report is made, and a safety valve is found that has been tampered with or out of order, the license of the engineer having such boiler in charge and the license of the master of such vessel shall be suspended or revoked.

It shall be the duty of the local inspectors to send a copy of this rule to every steamer in their district when said copies are furnished by the Department.

§ 4406, R. S.

15. All official records and official documents on file in the office of any supervising inspector or board of local inspectors, after official action thereon has been concluded, may be open to public inspection and examination: *Provided*, That such inspection or examination be made in the office to which such official records and documents belong.

RULE X.—MISCELLANEOUS.

(X)

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Cable for communication required on certain steamers	1
Draft of water on seagoing vessels to be limited	3
Fog bell required	11
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Signals between pilot and engineer on certain waters	9
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Watchmen and lookout for ocean steamers	7
Watchmen for passenger steamers	8

1. Steamers using the gong signals between the pilot house and engine room shall have a tube, of proper size, so arranged as to return the sound of the gong to the pilot house, and must also be provided with a speaking tube or other device for the purpose of conversation between pilot house and engine room. § 4405, R. S.

Nothing in the above shall be construed to prevent the use of the so-called telegraph now in use for conveying signals from the pilot house to the engine room, but in all cases where the telegraph is used the signal shall be repeated back.

On steamers where the distance is more than 150 feet between deck houses, a wire cable shall be stretched between the deck houses at all times when the vessel is loaded and being navigated, this cable to be not less than 5 feet from the deck; and there shall be attached at all times to the cable a traveler with a line of sufficient continuous length to insure its operation, in order that communication between both ends of the vessel may be facilitated at all times. Failure to have such cable stretched and traveler attached at all times when the vessel is loaded and being navigated shall be sufficient cause for the suspension of the license of the master or officer in charge.

On all steamers where the distance is more than 150 feet between perpendiculars of pilot house and forward part of the engine room, there shall be communication by means of a telephone between the pilot house and engine room, such telephone to be installed in lieu of a speaking tube.

2. Motor vessels of any tonnage other than steam vessels shall be provided with a whistle to be blown by compressed air or other power, to give the necessary whistle signals to passing vessels. § 4405, R. S.

(X)

LOAD LINE OF SEAGOING STEAM VESSELS.

§ 4405, R. S.

3. Local inspectors shall limit the draft of water on all inspected seagoing vessels, and note the same on the face of the certificate of inspection.

The owner, agent, or master of every inspected seagoing vessel shall indicate the draft of water at which he shall deem his vessel safe to be loaded for the trade she is engaged in, which limit, as indicated, shall be stated in the vessel's certificate of inspection, and it shall be unlawful for such vessel to be loaded deeper than stated in said certificate.

The master of every seagoing vessel shall, whenever leaving port, enter the maximum draft of his vessel in the log, and the master shall be held responsible that the authorized draft is not exceeded.

§ 4472, R. S.

^a4. None of the inflammable articles specified in section 4472, Revised Statutes, or oil that will not stand a fire test of 300° Fahrenheit shall be used as stores on any pleasure steamer or steamer carrying passengers.

§ 4472, R. S.

5. Refined petroleum which will not ignite at a temperature of less than 110° Fahrenheit may, upon routes where there is no other practicable mode of transporting it, be carried on passenger steamers; but it shall not be lawful to receive on board or transport any petroleum unless the owner or master of the steamer shall have first received from the inspectors a permit designating the place or places on such steamer in which the same may be carried or stowed, with the further condition that the permit shall be conspicuously posted on the steamer.

§ 4472, R. S.

6. Refined petroleum must not in any case be received on board or carried unless it is put up in good iron-bound casks or barrels or in good metallic cans or vessels, carefully packed in boxes, and the casks, barrels, or boxes plainly marked on the heads thereof with the manufacturer's name, the name of the article, and the degree of temperature (Fahrenheit) at which the petroleum will ignite.

§ 4477, R. S.

7. All steamers navigating the ocean during the nighttime shall have a lookout at or near the bow and one watchman in each cabin and steerage.

§ 4477, R. S.

8. All passenger steamers navigating rivers, lakes, bays, and sounds in the nighttime shall have a watchman on each deck below the hurricane deck, including the cabins, such as are accessible to the passengers and crew when under way; and a watchman as lookout at the bow, excepting on steamboats navigating the waters emptying into the Gulf of Mexico, having hurricane decks that terminate abaft the

^aThis section is qualified by the act of Congress approved May 28, 1906, which provides that "nothing in the provisions of this title [LII, Revised Statutes] shall prohibit the transportation by vessels not carrying passengers for hire, of gasoline or any of the products of petroleum for use as a source of motive power for the motor boats or launches of such vessels."

stem. Then the watchman, as lookout, shall be stationed on the forward part of such hurricane deck, who shall perform no other duty between sunset and sunrise. (X, 8)

9. STARTING, STOPPING, AND BACKING SIGNALS FOR STEAM VESSELS NAVIGATING THE WATERS OF THE EIGHTH AND NINTH SUPERVISING INSPECTION DISTRICTS, AND SO MUCH OF LAKE SUPERIOR AS IS INCLUDED IN THE FIFTH DISTRICT. § 4405, R. S.

The eighth district embraces all the waters of the lakes north and west of Lake Erie, with their tributaries, except the portion of Lake Superior which is bounded by the States of Minnesota and Wisconsin, and also includes the upper portion of the Illinois River down to and including Peoria, Ill.

The ninth district embraces all the waters of Lakes Erie, Ontario, Champlain, Memphremagog, and the river St. Lawrence, and their tributaries.

There shall be used between the master or pilot and engineer the following code of signals, to be made by bell or whistle, namely:

1 whistle or 1 bell	Go ahead.
1 whistle or 1 bell	Stop.
2 whistles or 2 bells	Back.
3 whistles or 3 bells	Check.
4 whistles or 4 bells	Strong.
4 whistles or 4 bells	All right.

Two whistles or two bells shall always mean back, irrespective of other signals previously given.

The signals between the pilot house and engine room on Alaskan rivers shall be as follows:

When at rest, 1 jingle	Stand by.
1 stroke of gong	Ahead full speed.
2 strokes of gong	Astern full speed.
1 stroke of gong	Stop when going ahead or astern.
1 stroke of gong and 1 jingle	Ahead half speed.
2 strokes of gong and 1 jingle	Astern half speed.
When going astern or ahead half speed, 1 jingle	Full speed.
When going astern or ahead full speed, 1 jingle	Half speed.
When going ahead or astern, any speed, 2 jingles	Very slow.

10. Any master or pilot of any steam vessel who shall flash or cause to be flashed the rays of the searchlight into the pilot house of a passing vessel shall be deemed guilty of misconduct and shall be liable to have his license suspended or revoked. § 4405, R. S.

11. The efficient fog bell required upon vessels by law shall be held to mean a bell not less than 8 inches in diam-

- (X, 11) eter from outside to outside, and constructed of bronze or brass or other material equal thereto in tone and volume of sound.

**RULES OF PRACTICE FOR THE GOVERNMENT OF SUPERVISING
AND LOCAL INSPECTORS OF STEAM VESSELS IN TRIALS OF
LICENSED OFFICERS OF VESSELS.**

I. APPLICATION AND ISSUE OF LICENSES.

§§ 4439, 4440,
4441, 4442, R. S.

1. Application for original license shall be made on the prescribed forms, and comply with the requirements of law.
2. Inspectors will furnish applicants with a written or printed notice of the time and place of examination.
3. If the inspectors shall decline to grant the applicant the license asked for they shall furnish him a statement, in writing, setting forth the cause of their refusal to grant the same.

II. SUSPENSION AND REVOCATION OF LICENSES.

§§ 4448, 4449,
4450, R. S.

1. The inspectors shall, when charges have been duly filed against a licensed officer of vessel, furnish the accused with a copy thereof, setting forth specifically their character and the section of the statutes or the rules of the board that have been violated.
2. Subpoenas shall be in the prescribed form, one copy of which shall be furnished each witness.
3. All testimony shall be reduced to writing. The accused shall be permitted to cross-examine witnesses, and in case of exceptions to questions for any cause the inspectors shall note the exceptions in the margin of the deposition. The deposition shall be signed by the witness and sworn to before an officer authorized to administer oaths.
4. The accused may have the hearing of the case continued upon the presentation of reasons satisfactory to the board, and the board may, in like manner, continue the hearing from day to day.
5. During the trial the witnesses shall be examined separately, but if the accused is also a witness he shall not be subject to this rule.
6. At any time before the conclusion of the evidence the charge or charges, if being tried on charges, may be amended, notice of said amendment being furnished to the accused of the nature of such amendment, but no amendment shall be permitted after the conclusion of the evidence.
7. Where the witnesses reside in a district other than that in which the accused is being tried, a certified copy of the charges, together with such interrogatories as the inspectors desire to propound, may be forwarded to the inspectors of the district where the witnesses reside, and said inspectors shall examine the witnesses in the same manner as prescribed in section 3 of this rule.
8. The testimony thus taken shall be forwarded to the inspectors investigating the case and read as evidence in

the cause, the same as though such testimony had been taken by the inspectors trying the same.

9. The inspectors will furnish the accused with a statement in writing of their finding in the premises.

10. The inspectors shall record in a well-bound book, to be furnished by the Department for that purpose, the charge or charges against the accused, the testimony of all witnesses, and their decision in the premises, which record shall be verified by their signatures.

III. APPEAL TO SUPERVISING INSPECTORS.

1. The supervising inspector, upon notice of an appeal from the decision of the local board, provided said notice of appeal shall be made within thirty days from the date of the decision of the local board, shall give notice in writing to said local board to forward a certified copy of their decision, together with the charges and all evidence in writing on file in their office. § 4452, R. S.

2. The supervising inspector shall then proceed to investigate the case under the same rules prescribed for the trial of the accused by the local board.

3. The testimony taken before the local board may be considered by the supervising inspector for the purpose of determining whether the finding of the local board is justified by the evidence, and he shall have power to remand the same for explanation or correction.

4. Upon the conclusion of the case the supervising inspector shall furnish the appellant with a notice of his finding in like manner as prescribed for local inspectors.

APPENDIX.

The following formulas, equivalent to those of the British Board of Trade, are given for the determination of the pitch, distance between rows of rivets, diagonal pitch, maximum pitch, and distance from centers of rivets to edge of lap of single and double riveted lap joints, for both iron and steel boilers:

Let p = greatest pitch of rivets in inches.
 n = number of rivets in one pitch.
 p_d = diagonal pitch in inches.
 d = diameter of rivets in inches.
 T = thickness of plate in inches.
 V = distance between rows of rivets in inches.
 E = distance from edge of plate to center of rivet in inches.

TO DETERMINE THE PITCH.

Iron plates and iron rivets:

$$p = \frac{d^2 \times .7854 \times n}{T} + d.$$

Example, first, for single-riveted joint: Given, thickness of plate (T) = $\frac{1}{2}$ inch, diameter of rivet (d) = $\frac{7}{8}$ inch. In this case $n=1$. Required the pitch.

Substituting in formula, and performing operation indicated,

$$\text{Pitch} = \frac{(\frac{7}{8})^2 \times .7854 \times 1}{\frac{1}{2}} + \frac{7}{8} = 2.077 \text{ inches.}$$

Example for double-riveted joint: Given, $t = \frac{1}{2}$ inch and $d = 1\frac{1}{8}$ inch. In this case $n=2$. Then—

$$\text{Pitch} = \frac{(\frac{9}{8})^2 \times .7854 \times 2}{\frac{1}{2}} + \frac{13}{16} = 2.886 \text{ inches.}$$

For *steel* plates and steel rivets:

$$p = \frac{23 \times d^2 \times .7854 \times n}{28 \times T} + d.$$

Example for single-riveted joint: Given, thickness of plate = $\frac{1}{2}$ inch, diameter of rivet = $1\frac{1}{8}$ inch. In this case $n=1$.

$$\text{Pitch} = \frac{23 \times (\frac{9}{8})^2 \times .7854 \times 1}{28 \times \frac{1}{2}} + \frac{15}{16} = 2.071 \text{ inches.}$$

Example for double-riveted joint: Given, thickness of plate = $\frac{1}{2}$ inch, diameter of rivet = $\frac{7}{8}$ inch. $n=2$. Then—

$$\text{Pitch} = \frac{23 \times (\frac{7}{8})^2 \times .7854 \times 2}{28 \times \frac{1}{2}} + \frac{7}{8} = 2.85 \text{ inches.}$$

FOR DISTANCE FROM CENTER OF RIVET TO EDGE OF LAP.

$$E = \frac{3 \times d}{2}.$$

Example: Given, diameter of rivet (d) = $\frac{7}{8}$ inch; required the distance from center of rivet to edge of plate.

$$E = \frac{3 \times \frac{7}{8}}{2} = 1.312 \text{ inches, for single or double riveted lap joint.}$$

FOR DISTANCE BETWEEN ROWS OF RIVETS.

The distance between lines of centers of rows of rivets for double, chain-riveted joints (V) should not be less than twice the diameter of rivet, but it is more desirable that V should not be less than $\frac{4d+1}{2}$.

Example under latter formula: Given, diameter of rivet = $\frac{7}{8}$ inch; then—

$$V = \frac{(4 \times \frac{7}{8}) + 1}{2} = 2.25 \text{ inches.}$$

For ordinary, double, zigzag riveted joints:

$$V = \frac{\sqrt{(11p + 4d)(p + 4d)}}{10}.$$

Example: Given, pitch = 2.85 inches, and diameter of rivet = $\frac{7}{8}$ inch; then—

$$V = \frac{\sqrt{(11 \times 2.85 + 4 \times \frac{7}{8})(2.85 + 4 \times \frac{7}{8})}}{10} = 1.487 \text{ inches.}$$

DIAGONAL PITCH.

For double, zigzag riveted lap joint. Iron and steel:

$$p_d = \frac{6p + 4d}{10}.$$

Example: Given, pitch = 2.85 inches, and $d = \frac{7}{8}$ inch; then—

$$p_d = \frac{(6 \times 2.85) + (4 \times \frac{7}{8})}{10} = 2.06 \text{ inches.}$$

MAXIMUM PITCHES FOR RIVETED LAP JOINTS.

For single-riveted lap joints:

$$\text{Maximum pitch} = (1.31 \times T) + 1\frac{5}{8}.$$

For double-riveted lap joints:

$$\text{Maximum pitch} = (2.62 \times T) + 1\frac{5}{8}.$$

Example: Given, a thickness of plate = $\frac{1}{2}$ inch, required the maximum pitch allowable.

For single-riveted lap joint:

$$\text{Maximum pitch} = (1.31 \times \frac{1}{2}) + 1\frac{5}{8} = 2.28 \text{ inches.}$$

For double-riveted lap joint:

$$\text{Maximum pitch} = (2.62 \times \frac{1}{2}) + 1\frac{5}{8} = 2.935 \text{ inches.}$$

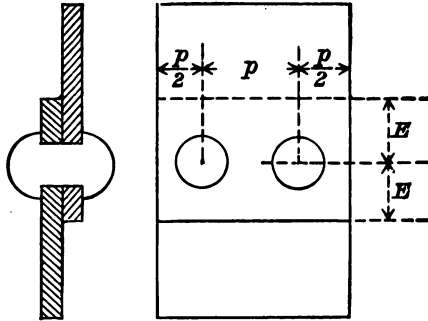
The following tables, taken from the handbook of Thomas W. Traill, entitled Boilers, Marine and Land; Their Construction and Strength, may be taken for use in single and double riveted joints as approximating the formulas of the British Board of Trade for such joints.

To determine the pitch of rivets from the above formulas, use the diameter and area of the rivet holes. The diameter of the rivets as given in the following tables is the diameter of the driven rivet.

Any riveted joint will be allowed when it is constructed so as to give an equal percentage of strength to that obtained by the use of the formula given.

IRON PLATES AND IRON RIVETS.

SINGLE-RIVETED LAP JOINTS.



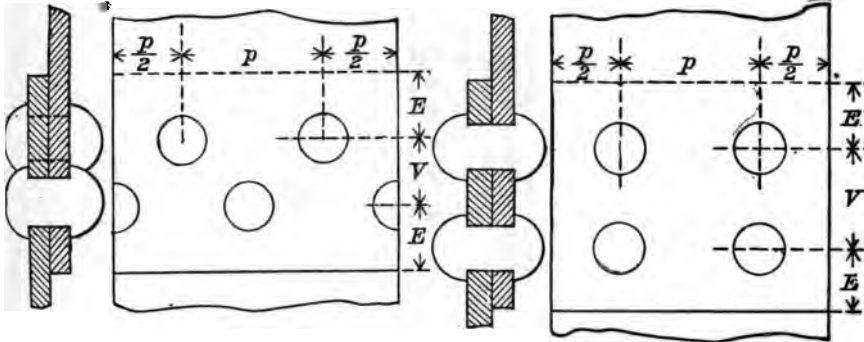
Thickness of plates.	Diameter of rivets.	Pitch of rivets.	Center of rivets to edge of plates.
T	d	p	E
$\frac{1}{8}$	$\frac{5}{8}$	1.524	.937
$\frac{3}{16}$	$\frac{3}{4}$	1.600	.984
$\frac{1}{4}$	$\frac{7}{8}$	1.676	1.031
$\frac{5}{16}$	$\frac{3}{4}$	1.753	1.078
$\frac{3}{8}$	$\frac{3}{4}$	1.829	1.125
$\frac{7}{16}$	$\frac{3}{4}$	1.905	1.171
$\frac{1}{2}$	$\frac{7}{8}$	1.981	1.218
$\frac{5}{8}$	$\frac{7}{8}$	2.036	1.265
$\frac{3}{4}$	$\frac{7}{8}$	2.077	1.312
$\frac{7}{8}$	$\frac{3}{4}$	2.120	1.359
$\frac{1}{2}$	$\frac{1}{2}$	2.164	1.406
$\frac{3}{8}$	$\frac{3}{8}$	2.210	1.453
$\frac{1}{4}$	1	2.256	1.500
$\frac{3}{16}$	$1\frac{1}{8}$	2.304	1.546
$\frac{1}{8}$	$1\frac{1}{8}$	2.352	1.593
$\frac{3}{32}$	$1\frac{3}{8}$	2.400	1.640
$\frac{1}{4}$	$1\frac{1}{2}$	2.450	1.687
$\frac{5}{16}$	$1\frac{5}{8}$	2.500	1.734
$\frac{3}{8}$	$1\frac{3}{4}$	2.550	1.781
$\frac{7}{16}$	$1\frac{7}{8}$	2.601	1.828
$\frac{1}{2}$	$1\frac{1}{2}$	2.652	1.875
$\frac{5}{8}$	$1\frac{3}{4}$	2.703	1.921
$\frac{3}{4}$	$1\frac{5}{8}$	2.755	1.968

IRON PLATES AND IRON RIVETS.

DOUBLE-RIVETED LAP JOINTS.

ZIGZAG RIVETING.

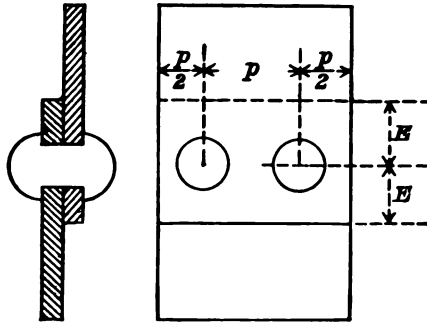
CHAIN RIVETING.



Thickness of plates.	Diameter of rivets.	Pitch of rivets.	Center of rivets to edge of plates.	Distance between rows of rivets.	
				Zigzag riveting.	Chain riveting.
T	d	p	E	V	V
$\frac{1}{8}$	$\frac{5}{8}$	2.272	.937	1.145	1.750
$\frac{1}{4}$	$\frac{3}{4}$	2.386	.984	1.202	1.812
$\frac{3}{8}$	$\frac{7}{8}$	2.500	1.031	1.260	1.875
$\frac{1}{2}$	$\frac{1}{2}$	2.613	1.078	1.317	1.937
$\frac{5}{8}$	$\frac{3}{4}$	2.727	1.125	1.374	2.000
$\frac{3}{4}$	$\frac{7}{8}$	2.826	1.171	1.426	2.062
$\frac{7}{8}$	$\frac{1}{2}$	2.886	1.218	1.465	2.125
1	$\frac{3}{4}$	2.948	1.265	1.504	2.187
$1\frac{1}{8}$	$\frac{7}{8}$	3.013	1.312	1.544	2.250
$1\frac{1}{4}$	$\frac{1}{2}$	3.079	1.359	1.585	2.312
$1\frac{1}{2}$	$\frac{3}{4}$	3.146	1.406	1.626	2.375
$1\frac{3}{4}$	$\frac{7}{8}$	3.215	1.453	1.667	2.437
$1\frac{7}{8}$	1	3.284	1.500	1.709	2.500
2	$1\frac{1}{8}$	3.355	1.546	1.751	2.562
$2\frac{1}{8}$	$1\frac{1}{4}$	3.426	1.593	1.794	2.625
$2\frac{1}{2}$	$1\frac{3}{8}$	3.498	1.640	1.836	2.687
$2\frac{3}{8}$	$1\frac{1}{2}$	3.571	1.687	1.879	2.750
$2\frac{1}{2}$	$1\frac{5}{8}$	3.645	1.734	1.923	2.812
$2\frac{7}{8}$	$1\frac{3}{4}$	3.718	1.781	1.966	2.875
3	$1\frac{7}{8}$	3.793	1.828	2.009	2.937
$3\frac{1}{8}$	$1\frac{1}{4}$	3.867	1.875	2.053	3.000
$3\frac{1}{2}$	$1\frac{3}{4}$	3.942	1.921	2.096	3.062
4	$1\frac{1}{2}$	4.018	1.968	2.140	3.125

STEEL PLATES AND STEEL RIVETS.

SINGLE-RIVETED LAP JOINTS.

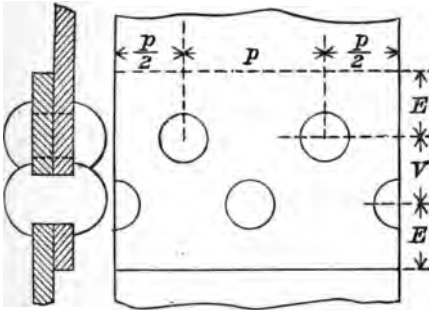


Thickness of plates.	Diameter of rivets.	Pitch of rivets.	Center of rivets to edge of plates.
T	d	p	E
$\frac{1}{8}$	$\frac{1}{8}$	1.562	1.031
$\frac{1}{4}$	$\frac{1}{4}$	1.633	1.078
$\frac{3}{8}$	$\frac{1}{2}$	1.704	1.125
$\frac{1}{2}$	$\frac{3}{8}$	1.775	1.171
$\frac{5}{8}$	$\frac{1}{2}$	1.846	1.218
$\frac{3}{4}$	$\frac{3}{4}$	1.917	1.265
$\frac{7}{8}$	$\frac{7}{8}$	1.988	1.312
1	1	2.036	1.359
$1\frac{1}{8}$	$1\frac{1}{8}$	2.071	1.406
$1\frac{1}{4}$	$1\frac{1}{4}$	2.108	1.453
$1\frac{3}{8}$	1	2.146	1.500
$1\frac{1}{2}$	$1\frac{3}{8}$	2.186	1.546
$1\frac{5}{8}$	$1\frac{1}{2}$	2.227	1.593
$1\frac{3}{4}$	$1\frac{3}{4}$	2.269	1.640
$1\frac{7}{8}$	$1\frac{3}{4}$	2.312	1.687
2	$1\frac{7}{8}$	2.356	1.734
$2\frac{1}{8}$	2	2.400	1.781
$2\frac{1}{4}$	2	2.445	1.828
$2\frac{3}{8}$	$2\frac{1}{4}$	2.500	1.875
$2\frac{1}{2}$	$2\frac{3}{8}$	2.562	1.921
$2\frac{5}{8}$	$2\frac{1}{2}$	2.625	1.968
$2\frac{3}{4}$	$2\frac{3}{4}$	2.687	2.015
$2\frac{7}{8}$	$2\frac{3}{4}$	2.750	2.062

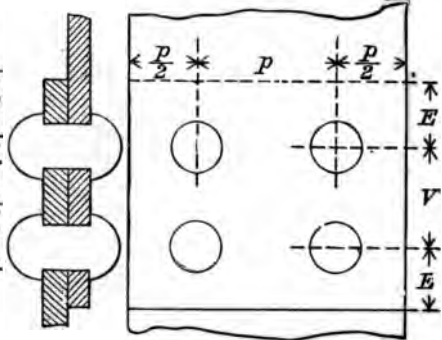
STEEL PLATES AND STEEL RIVETS.

DOUBLE-RIVETED LAP JOINTS.

ZIGZAG RIVETING.



CHAIN RIVETING.



Thickness of plates.	Diameter of rivets.	Pitch of rivets.	Center of rivets to edge of plates.	Distance between rows of rivets.	
				Zigzag riveting.	Chain riveting.
T	d	p	E	V	V
$\frac{5}{16}$	$\frac{11}{16}$	2.291	1.031	1.187	1.875
$\frac{11}{32}$	$\frac{23}{32}$	2.395	1.078	1.240	1.937
$\frac{3}{8}$	$\frac{3}{4}$	2.500	1.125	1.295	2.000
$\frac{13}{32}$	$\frac{25}{32}$	2.604	1.171	1.349	2.062
$\frac{7}{16}$	$\frac{13}{16}$	2.708	1.218	1.403	2.125
$\frac{15}{32}$	$\frac{27}{32}$	2.803	1.265	1.453	2.187
$\frac{1}{2}$	$\frac{7}{8}$	2.850	1.312	1.487	2.250
$\frac{17}{32}$	$\frac{29}{32}$	2.900	1.359	1.522	2.312
$\frac{9}{16}$	$\frac{15}{16}$	2.953	1.406	1.558	2.375
$\frac{19}{32}$	$\frac{31}{32}$	3.008	1.453	1.595	2.437
$\frac{5}{8}$	1	3.064	1.500	1.631	2.500
$\frac{21}{32}$	$1\frac{1}{32}$	3.122	1.546	1.669	2.562
$\frac{11}{16}$	$1\frac{1}{16}$	3.181	1.593	1.707	2.625
$\frac{23}{32}$	$1\frac{3}{32}$	3.241	1.640	1.745	2.687
$\frac{3}{4}$	$1\frac{1}{8}$	3.302	1.687	1.784	2.750
$\frac{25}{32}$	$1\frac{5}{32}$	3.364	1.734	1.823	2.812
$\frac{13}{16}$	$1\frac{3}{16}$	3.427	1.781	1.863	2.875
$\frac{27}{32}$	$1\frac{7}{32}$	3.490	1.828	1.902	2.937
$\frac{7}{8}$	$1\frac{1}{4}$	3.554	1.875	1.942	3.000
$\frac{29}{32}$	$1\frac{9}{32}$	3.618	1.921	1.981	3.062
$\frac{15}{16}$	$1\frac{5}{16}$	3.683	1.968	2.021	3.125
$\frac{31}{32}$	$1\frac{11}{32}$	3.748	2.015	2.061	3.187
1	$1\frac{1}{8}$	3.814	2.062	2.102	3.250

RULES OF ORDER.

ADOPTED AT THE SPECIAL MEETING HELD JUNE, 1871—AMENDED
JANUARY 29, 1885.

I. The president shall take the chair at the hour appointed, a quorum being present, and shall call the Board to order, when the secretary shall read the proceedings of the preceding day, which, if correct, shall be approved, and the following order of business be observed:

First. Presentation of communications by districts.

Second. Motions and resolutions.

Third. Presentation of memorials and petitions.

Fourth. Reports of committees of the Board.

Fifth. Miscellaneous business.

II. The president shall preserve decorum and order; he shall pronounce the decision of the Board on all subjects, and shall decide all questions of order without debate, unless, entertaining doubts on the point of order raised, he may call for the sense of the Board; he may speak on points of order only, rising from his seat; he may also on any other occasion call any member to the chair, and while on the floor he shall have the privilege of entering into any debate on any question before the Board; such substitution, however, shall not extend beyond an adjournment. An appeal may be made from the decision of the president by any two members, on which no member shall speak more than once without leave of the Board.

III. Any member who shall deliver his opinion or speak in any debate shall rise in his place and respectfully address the president, and shall confine himself to the question under debate, and avoid personality. If two or more members rise to speak at the same time, the president shall decide who shall speak first.

IV. No member shall speak more than twice on the same question without leave of the Board; nor more than once until every member choosing to do so shall have spoken.

V. If a member, while speaking, is called to order by the president or by any other member, he shall cease speaking until it is determined whether he is in order or not, and the objectionable words shall, if required, be reduced to writing.

VI. No motion shall be debated or open for discussion or decision until the same has been seconded, and it shall be reduced to writing if desired by the president or any member.

VII. When a question is before the Board no motion shall be received but to adjourn, to lay on the table, to postpone indefinitely,

to postpone to a certain day, to commit, to amend; which several motions shall have precedence in the order they here stand arranged.

VIII. A motion to adjourn shall always be in order, and shall be decided without debate. When a question is postponed indefinitely, the same shall not be acted upon again or reconsidered during the session of the Board.

IX. When the yeas and nays shall be called on any question, which may be done when three members require it, the secretary shall call the names of the members by districts, commencing with the first, when the members present shall answer affirmatively or negatively as their names are called, unless they shall be excused by the Board: *Provided, however,* That the yeas and nays shall always be called upon the adoption of a rule or device requiring the approval of the Secretary of Commerce and Labor. The absentees and those not voting shall also be recorded.

X. Any member may call for the division of a question when the sense will admit of it.

XI. When a blank is to be filled, and different sums, numbers, or times shall be proposed, the question shall first be taken on the highest sum or number and on the longest or latest time.

XII. When the reading of any paper or other matter is called for, and the same is objected to by any member, it shall be determined by a vote of the Board.

XIII. Every member of the Board present shall vote on all questions unless excused by the Board and all questions shall be decided by a majority of votes, except in cases otherwise provided.

XIV. No motion for reconsideration shall be received, unless made by a member and seconded by another who voted in the majority on the question.

XV. All committees shall be appointed by the president unless otherwise ordered by the Board on motion, in which case they may be appointed by ballot or *viva voce*.

XVI. Before putting the question the president shall ask: "Is the Board ready for the question?" If no member rise to speak, and a majority of the Board are ready for the question, the president shall put the question; and after doing so, no member shall speak upon it.

XVII. If a pending question be lost by adjournment of the Board, and revived on the succeeding day, no member who shall have spoken upon it twice on the preceding day shall be permitted again to speak on it without leave.

XVIII. When a motion is made to lay on the table, the question shall be taken without debate.

XIX. Any one or more of the foregoing standing rules may be altered or amended when a majority of the Board shall so determine, provided a motion to alter, amend, or change shall have been at least one day before the Board.

XX. All cases of order not herein provided for shall be governed, in the discretion of the Board, by the best uses in like cases, particularly such as prevail in the Congress of the United States.

XXI. The Board shall, at every session, elect one of its members as secretary.

INSTRUMENTS, MACHINES, AND EQUIPMENTS APPROVED FOR USE ON STEAM VESSELS.

[Year in which approved is given in parentheses.]

LIFE RAFTS.

- American Flexible Life Raft Company. (1877.)
- Ammen metallic balsa or life raft. (1895.)
- M. A. Bryson's deer-hair life raft. (1877.)
- Beasley's life raft. (1881.)
- Barstow's self-detaching life raft. (1881.)
- Hon. H. C. Calkin's, New York, metallic raft. (1872.)
- Clark's life raft. (1873.)
- J. A. Cone. (1875.)
- J. A. Cone's life raft (Drein & Son), Wilmington, Del. (1886.)
- Columbia life raft, Churchman & Groves, Philadelphia, Pa. (1886.)
- Chamber's life raft. (1888.)
- Carley life float, Carley Life Float Company, M. T. Whiton, president. (1901.)
- Davis's life raft. (1877.)
- Frazee Life Raft Company, New York, metallic raft. (1872.)
- Griffith life raft. (1890.)
- Edwin A. Hay's life raft. (1883.)
- Emmett Harding's combined life raft and settee, when cylinders are constructed of metal. (1884.)
- Hussey life raft. (1894.)
- O. R. Ingersoll, New York, metallic raft. (1872.)
- O. R. Ingersoll's life raft, canvas cylinders covered with rattan, when provided with cross braces and air-tight valves for determining its air-tight condition. (1884.)
- O. R. Ingersoll's life raft, composed of two cylinders made of cane and filled with block cork. (1887.)
- David Kahnweiler's metallic life raft. (1888.)
- Le Duc Tule Improvement Company's life raft, San Francisco, Cal. (1886.)
- Lane and De Groot, Brooklyn, N. Y., metallic life raft. (1898.)
- Miller's life-saving raft. (1881.)
- Moran Brothers Company, Seattle, Wash., metallic life raft. (1906.)
- Ogden's life raft. (1874.)
- Rider's life raft. (1877.)
- Robert Roberts's metallic raft. (1884.)
- Lewis H. Raymond's life raft. (1881.)
- L. H. Raymond, the "Reliance" metallic life raft. (1896.)
- W. S. Ray Manufacturing Company, San Francisco, Cal., metallic life raft. (1906.)
- John T. Smith's metallic life raft, when the cylinders are provided with water-tight bulkheads placed not over 2 feet apart. (1884.)

John T. Smith's life raft, when constructed of galvanized iron of not less than 24 wire gauge, Birmingham standard, in thickness. (1885.)

Torrey & Co. (1872.)

Woolsey's life buoy. Rated for two persons, for lake, bay, and river, when made, as at present, of 52 pounds of cork, and in that proportion when containing a greater amount of cork. (1881-1883.)

F. H. Ward's metallic folding life raft. (1897.)

LIFEBOATS.

Aniello lifeboat. (1895.)

P. R. Beaupré, Metropolis, Ill., automatic self righting and bailing lifeboat. (1872.)

Burke, Wise & Co.'s lifeboat lowering and launching apparatus. (1878.)

Baswitz lifeboat. (1897.)

Berthon collapsable lifeboat. (1897.)

Dickinson's self-righting lifeboat. (1881.)

Dean & Co.'s improved diagonal lifeboat. (1883.)

Dobbin's lifeboat. (1885.)

Dobbin's metallic lifeboat. (1888.)

Thomas Drein & Sons, Wilmington, Del., corrugated metallic lifeboat, when fitted with suitable bottom boards of usual form to prevent the bulging of the floor plates by falling timbers. (1900.)

J. Walter Douglas, lifeboat. (1893.)

Eddy's patent sea lifeboat. (1883.)

Engelhardt collapsable (folding) lifeboat, The Engelhardt Collapsible Lifeboat Company, Long Island City, N. Y. (1904.)

George Judson's lifeboat. (1878.)

O. R. Ingersoll, self-righting and self-bailing lifeboat. (1887.)

Mayo Rescue lifeboat, R. D. Mayo, Muskegon, Mich. (1901.)

Mayo Junior lifeboat, Robert D. Mayo, jr., Hopkins Station, Mich. (1904.)

F. L. Norton's lifeboat; boats to be built of yellow metal. (1887.)

W. J. Nunan's lifeboat. (1897.)

Richardson's self-righting and self-bailing lifeboat. (1884.)

Mr. Stoddars's self-righting and self-bailing lifeboat. (1872.)

Shear's self-bailing and self-righting boat. (1873.)

William H. Taylor's lifeboat. (1894.)

Myers's lifeboat. (1905.)

LIFE-PRESERVERS.

Armstrong Bros. & Co., granulated cork. (1885.)

Bryson's deer-hair life-preserver. (1877.)

R. Beeching & Co., granulated cork. (1885.)

H. Brunswick, life-saving buoy. (1898.)

E. Clark, cork life-preserver. (1872.)

George Clark, jr., life-preserver. (1878.)

Eliza R. Cogswell, life-preserver invented by. (1883.)

James S. Dunant's California tule life-preserver, when ends of tule are bound with copper wire. (1884.)

Godfrey & Boyce's life-preserver. (1875.)
 W. H. Godfrey, granulated cork. (1885.)
 J. B. Hamilton's life-preserver, Springfield, Mass. (1901.)
 O. R. Ingersoll, cork life-preserver. (1872.)
 Kahnweiler's never-sink life-preserver. (1874.)
 Kahnweiler's improved granulated cork life-preserver. (1878.)
 D. Kahnweiler & Son's pressed-cork life-preserver. (1894.)
 Le Duc Tule Improvement Company's life-preserver, when ends of
 tule are bound with copper wire. (1886.)
 C. M. Lane, of the Lane & De Groot Company, Long Island City,
 N. Y., the Ravenswood life-preserver. (1904.)
 C. S. Merriman, rubber life-saving dress. (1877.)
 Joseph K. McCammon, the Le Duc. (1887.)
 Morrison Life Belt Co., St. Louis, Mo., cork life-preserver. (1904.)
 Fitch Reynolds's cork life-preserver. (1879.)
 John Robinson & Co., granulated cork. (1885.)
 J. A. Seamans, cork life-preserver. (1872.)
 M. A. Scott, cork life-preserver. (1872.)
 John T. Smith's life-preserver, New York. (1892.)
 The Edward Maynard life-preserver, presented by John T. Smith,
 New York. (1887.)
 Truslow & Co., granulated cork. (1885.)
 White & Hay's cork life jacket. (1878.)
 Upson-Walton Company, solid cork life-preservers. (1905.)
 Butz block-cork life-preserver. (1905.)
 National Cork Company, life-preserver. (1904.)

LINE-CARRYING GUNS AND PROJECTILES.

Cunningham self line-carrying rocket. (1890.)
 Cunningham small rocket for vessels of 500 tons and over 100 tons.
 (October 9, 1891.)
 Hunt's line-carrying gun, large. (1890.)
 Hunt's line-carrying gun, small. May be used on all vessels from
 100 to 500 tons. (1890.)
 Hunt gun, No. 2, 20 inches long, 2½ inches diameter of bore. May
 be used on steam vessels from 100 to 500 tons when the gun is con-
 structed in all its parts of material same as used in the large Hunt gun
 already approved by this Board. (1893.)
 Lyle line-carrying gun. (1890.)
 Lyle life-saving shoulder gun may be used on all vessels not exceed-
 ing 300 gross tons. (1906.)

STEAM PUMPS.

Coll's single-suction steam siphon, presented by Mr. Coll, Pittsburg.
 (1872.)
 Coll's improved steam siphon pump. (1874.)
 Hall's duplex steam pump. (1889.)
 Landsell's double-suction steam siphon, presented by H. S. Land-
 sell, New York. (1872.)
 A. Sluthouer, New Philadelphia, Ohio, fire and bilge pump. (1872.)

Sheriff's steam siphon pump. (1875.)
 Van Duzen & Tift's steam jet pump, for use as a steam fire pump
 on steamers of 100 tons and under. (1884.)

SAFETY VALVES.

Common lever valve. (1884.)
 H. G. Ashton, East Cambridge, Mass. (1872.)
 Ashcroft's safety valve. (1877.)
 American Steam Gauge Company, Boston, Mass.; American spring
 safety valve. (1885.)
 Adams spring safety valve, manufactured by Thomas Adams & Co.,
 Manchester, England; presented by Luther D. Lovekin, Camden,
 N. J. (1903.)
 Case & Bailey, Detroit, Mich. (1872.)
 Cockburn's safety valve. (1877.)
 Crosby's safety valve. (1877.)
 George E. Collyer, safety valve. (1883.)
 Consolidated Safety Valve Company, Boston, Mass.; steam and
 vacuum gauge. (1884.)
 Crosby & Meady, pop safety valve. (1888.)
 J. M. Coale's pop safety valve and muffler. (1894.)
 Crane pop safety valve, presented by The Crane Company. (1895.)
 Dry Dock Engine Works, Detroit, Mich. (1873.)
 Spring-loaded safety valve, presented by the James W. Elwell & Co.,
 New York, N. Y., manufactured by Lethuillier & Pinel, Rouen, France.
 Hodgin's safety valve. (1877.)
 Herreshoff Manufacturing Company, pop safety valve. (1883.)
 Hall's incased safety valve, when lever is permanently attached to
 valve casing. (1889.)
 Norman L. Hayden, Columbus, Ohio, Tippetts spring safety valve.
 (1903.)
 The N. L. Hayden Mfg. Co., Columbus, Ohio, Hercules spring-
 loaded safety valve. (1904.)
 E. B. Kunkle, spring-loaded safety valve. (1886.)
 I. T. Kearns, pop safety valve. (1893.)
 J. D. Lynde, Philadelphia, Pa. (1872.)
 F. Lunkenheimer, safety valve. (1888.)
 The Lunkenheimer improved pop safety valve. (1896.)
 Morse's safety valve. (1877.)
 A. Orme's safety valve. (1877.)
 W. E. Pierson, pop valve. (1883.)
 Richardson & Co., Troy, N. Y. (1872.)
 R. F. Silliman's safety valve. (1884.)
 Roe Stephens Manufacturing Company, Detroit, Mich., spring
 safety valve. (1892.)
 Star Brass Manufacturing Company, pop safety valve. (1898.)
 H. G. Trout, King Iron Works, Buffalo, N. Y., spring-loaded safety
 valve, and allowed a rating of 2 square feet of grate surface of boiler
 to 1 square inch area of valve. (1885.)
 Utica pop safety valve, presented by the Utica Steam Gauge Com-
 pany, of Frankfort, N. Y. (1900.)

FIRE EXTINGUISHERS.

(Approved in 1905, except those approved in 1906.)

Liquid chemical fire extinguishers approved for use on steamers carrying passengers, when liquid is contained in copper cylinders tested and guaranteed to withstand a pressure of at least 350 pounds to the square inch:

Accurate, Acme, Babcock No. 1, Badger, Boyd Marine, Childs, Columbia, Competitor, Crescent (1906), Diggs Automatic, Diggs Upright, Ecnarusni, Holloway, Handley's Cageless, Improved Standard, Insurance, International, Keystone, Marine Rex, Metropolitan, Metropolitan No. 2, Minimax, Monarch (1906), National (1906), National Standard, Patrol, Phoenix, Quick Action, Railway and Marine, Regina, Rex, Royal, Salvage, Standard, Stempel, Underwriters, United States, United States 2nd style, Utica No. 2 (without hose), Utica No. 3 (without hose), Utica No. 7 (with stopcock and without hose, 1906), Utica No. 8 (with stopcock and without hose, 1906), and Victor.

Little Giant (of the pump type and 3-gallon capacity).

Fire extinguishers approved for use, but not allowed as substitute for the fire extinguishers required by Rule IV, section 13:

American, Excelsior, Fyricide, Motor Rex, Nevermyss (without hose).

MISCELLANEOUS.

Automatic boat-leak detector, presented by W. F. Cogan, Hoboken, N. J. (1906.)

Boat unlashing device, presented by Henry Bowden, Norfolk, Va. (1906.)

Carpentier automatic safety stop valve, presented by John Twohy, of Norfolk, Va. (1900.)

Clayton fire-extinguishing system. (1905.)

Cap for boat plug, presented by James Burcher, Philadelphia, Pa. (1906.)

Chair for holding a life-preserver, presented by George Fentrick, New York, N. Y. (1906.)

Downs fusible-plug stopper, when manufactured of noncorrosive metal; presented by Geo. H. Waters, West New Brighton, N. Y. (1904.)

Dobler boiler attachment, presented by W. R. Miller, New York, N. Y. (1906.)

Flash light, presented by Joshua W. Atlee, Philadelphia, Pa. (1906.)

Garrity's mechanical straining and filtering apparatus, when manufactured of iron or steel plates stamped and tested the same as required by Rule I for boiler plates; presented by the Garrity Filter Company, New Orleans, La. (1904.)

Ideal automatic pump governor, presented by the Ideal Automatic Pump Governor Company, New York, N. Y. (1906.)

Irvine-Lihou boat handler, presented by Marine Safety Appliance Company, New York, N. Y. (1906.)

Lewis H. Raymond's boat plug. (1881.)

New England Navigation Company's standard boat-disengaging gear. (1906.)

- Renton's safety boat plug. (1883.)
 Rich fire indicator. (1905.)
 Raymond boat releasing hook, presented by James R. Raymond, New York, N. Y. (1906.)
 James Snelgrove's automatic boat plug. (1883.)
 Tanks or air chambers, presented by Capt. J. W. Shackford, of New York, N. Y., formed of reindurated wood and placed in boats of steam vessels constructed abroad. (1900.)

COIL AND PIPE BOILERS.

[Coil boilers and other boilers approved under section 4429, Revised Statutes.]

- F. D. Althouse, New York, N. Y. (1889.)
 F. S. Allen, New York, N. Y. (1884.)
 Almy Water Tube Boiler Company, Providence, R. I. (Types A, B, and C, 1890; types D and E, 1897.)
 George W. Arrowsmith, Fort Niagara, N. Y. (1894.)
 American Fire Engine Company, Cincinnati, Ohio. (1900.)
 Authentic water-tube boiler, Bugbee & Laycock, Chicago, Ill. (1901.)
 Acme boiler, Detroit Water Tube Boiler Company, Detroit, Mich. (1902.)
 J. L. Anderson, Seattle, Wash. (1904.)
 A. Perry Blivin, Brooklyn, N. Y. (1885.)
 Park water-tube boiler, by the Aultman and Taylor Machinery Company, Mansfield, Ohio. (1905.)
 C. M. Raymond steam boiler, The Dieter Steam Engine Company, New York, N. Y. (1905.)
 Stickney safety steam generator, H. R. Stickney, Portland, Me. (1905.)
 Spokane Machinery Supply Co., water-tube boiler. (1905.)
 Charles G. Rogers, water-tube boiler (modified form Roberts coil boiler), Pittsburg, Pa. (1905.)
 The Bonson furnace boiler, Chicago, Ill. (1905.)
 The W. D. McNaull water-tube boiler, Toledo, Ohio. (1905.)
 George B. Brayton, Providence, R. I. (1885.)
 The Belleville boiler, presented by Miers Coryell, of New York. (1887.)
 Brigham & Markham, Hartford, Conn. (1889.)
 Braggin's, Rochester Machine Tool Works, Rochester, N. Y. (1889.)
 Bowdish, Skaneateles, N. Y. (1890.)
 John E. T. Bartlett, Brooklyn, N. Y. (1891.)
 Alfred Box & Co., Philadelphia, Pa. (1892.)
 Ira Bradley, Malden, Mass. (1892.)
 Augustus Bailey, Spuyten Duyvil, N. Y. (1893.)
 George D. Bower, Trenton, N. J. (1893.)
 Babcock & Wilcox, New York, N. Y. (1894.)
 L. Boyer's Sons, New York, N. Y. (1894, 1901.)
 Buschmann & Layman, Baltimore, Md. (1895, 1897.)
 John Bonner, Tiburon, Cal. (1895.)
 C. R. Benton, Vergennes, Vt. (1896.)
 Buckley patent water-tube pipe boiler, Rochester Machine Tool Works, Rochester, N. Y. (1896.)

- Barr, Reynolds & Co., Rochester, N. Y.; E. P. Clapp boiler No. 1. (1897.)
- George Bolland, Pittsburg, Pa. (1897.)
- Bretherton boiler, James C. Wignall, Philadelphia, Pa. (1897.)
- A. J. Beach, Moline, Ill. (1898.)
- Joseph G. Brassard, Central Falls, R. I. (1898.)
- Edward Bounds, Pittsburg, Pa. (1898.)
- James H. Brown, Boston, Mass. (1898.)
- Barr & Creelman, Rochester, N. Y. (1900.)
- W. J. Boland, Chicago, Ill. (1900.)
- Bugbee & Laycock, Chicago, Ill. Authentic water-tube boiler. (1901.)
- Barton Boiler Company, Chicago, Ill.; Barton's Flash boiler. (1904.)
- Fred A. Ballin, Portland, Oreg. (1906.)
- B. F. Binnix, Washington, D. C. (1906.)
- C. H. Caswell, Newport, R. I. (1887.)
- Miers Coryell, New York; The Belleville boiler. (1887.)
- Copeland boiler, when composed in all its parts of wrought iron, copper, brass, or steel; Northrop Manufacturing Company. (1888.)
- H. B. Cumming, Malden, Mass. (1889.)
- C. B. Crowley & E. G. Browne, Brooklyn, N. Y. (1889.)
- Clapp & Jones Manufacturing Company, Hudson, N. Y. (1889.)
- Crawford & Saunier's, Newark, N. J. ("Passaic," 1890; "Gem," 1891.)
- Cruikshank's, Providence, R. I. (1890.)
- E. J. Copeland, New York, N. Y. (1891.)
- "Cary's" steam generator changed from "Gray's," Providence, R. I. (1891.)
- Edward S. Clark, Boston, Mass. (1891, 1895, 1898.)
- Clonbrock Steam Boiler Company, Brooklyn, N. Y. (1891, 1902.)
- Clay & Torbensen, Camden, N. J. (1892.)
- Cole & Reinhart, Camden, N. J. (1892.)
- Louis S. Clark, Pittsburg, Pa. (1893.)
- A. E. Corey, Allegheny, Pa. (1893.)
- Coller Yacht and Engine Works, Detroit, Mich.; Coller sectional boiler. (1893, 1895.)
- E. P. Clark, New York, N. Y. (1894.)
- The Coulter & McKenzie Machine Company, Bridgeport, Conn. (1894.)
- Christiansen marine boiler; John A. Duggan, Boston, Mass. (1894.)
- C. R. Cowley, Brooklyn, N. Y. (1895.)
- Baylies C. Clark, New York, N. Y. (1896.)
- J. F. Craig, Toledo, Ohio; Craig water-tube boilers, Nos. 1 and 2. (1896.)
- E. P. Clapp boiler No. 1; Barr, Reynolds & Co., Rochester, N. Y. (1897.)
- William Cramp & Sons, Philadelphia, Pa.; Yarrow type No. 2, and Niclausse water-tube boiler. (1897.)
- W. T. Clark, Boston, Mass. (1897.)
- Osceola Currier, Newark, N. J. (1897.)
- E. P. Chancellor, Parkersburg, W. Va. (1898.)
- J. Castleman, Brooklyn, N. Y.; T. F. Morrins pipe boiler. (1898.)

- James Carnegie, New York, N. Y.; type "B." (1899.)
 Peter Cone, Jacksonville, Fla. (1899.)
 Ed Cheetham, Detroit, Mich. (1900.)
 Chas. R. Cowley and Howell C. Cooper, Everett, Mass.; Cowley and Cooper boiler. (1901.)
 Charles D. Casad, Seattle, Wash. (1902.)
 C. B. Clark, South Brewer, Me. (1902.)
 B. F. Cook, Fort Pierce, Fla. (1902.)
 E. J. Codd, Baltimore, Md.; Smith patent boiler. (1904.)
 Will F. Cook, Oshkosh, Wis. (1906.)
 E. G. Durant, for using petroleum. (1888.)
 L. D. Davis, Erie, Pa. (1891, 1894, 1898.)
 Anson C. Dearing, Detroit, Mich. (1894.)
 Charles De Vore, Philadelphia, Pa. (1894.)
 J. J. Driscoll, Stapleton, N. Y. (1894.)
 George E. Dow, Seattle, Wash. (1894.)
 John A. Duggan, Boston, Mass.; Christiansen marine boiler. (1894.)
 J. W. Dawson, Wyandotte, Mich. (1895.)
 E. N. Drouillard, Wyandotte, Mich.; Drouillard water-tube boiler No. 1. (1896.)
 Daring type Thornycroft pipe boiler, Thorpe, Platt & Co., New York, N. Y. (1897.)
 Robert Don, Stockton, Cal. (1897.)
 Dearing water-tube boiler, Detroit, Mich. (1897.)
 Detroit Screw Works, Detroit, Mich.; Taylor boiler. (1898.)
 A. D. Davis, Yonkers, N. Y. (1899.)
 Detroit Water-Tube Boiler Company, Detroit, Mich. (1899.) The "Acme" boiler. (1902.)
 W. E. Dickey, New York, N. Y.; porcupine boiler. (1902.)
 C. F. Davenport, Brooklyn, N. Y., assigned to Empire State Engineering Company, New York, N. Y. (1904.)
 William F. Duval, Jersey City, N. J. (1904.)
 Dobler boiler attachment or water heater, presented by W. R. Miller, New York, N. Y. (1906.)
 F. W. Edwards, Bayonne, N. J. (1899.)
 Benjamin P. Emery, Kennebunkport, Me. (1899.)
 Henry Ernst, New York, N. Y. (1901.)
 A. C. Evans, Norfolk, Va. (1901.)
 Farnie & Geer, Syracuse, N. Y.; the Farnie boiler, steam pressure to be allowed on such boiler as the bracing will entitle the same to carry. (1887.)
 Hugo L. Frederick, copper boiler. (1889.)
 William Flaggs, Brooklyn, N. Y. (1891.)
 Charles W. Foster, New Haven, Conn. (1892, 1894, 1895.)
 W. S. Fairchild, Newark, N. J. (1892.)
 Walter B. Fowler, Lawrence, Mass. (1892.)
 H. H. Frederick, New Orleans, 3 horsepower. (1893.)
 Thomas Fearon, Yonkers, N. Y. (1893, 1895, 1897.)
 Fenlayson & Popkins, Detroit, Mich. (1893.)
 John A. Flajole, Bay City, Mich. (1894.)
 William Flagg, Bayonne, N. J. (1895, 1898.)
 H. E. Frauz, steam generator; presented by J. H. Mittendorff, Washington, D. C. (1895.)

- A. W. Finlayson, Detroit, Mich. (1896.)
 Fore River Engine Company, Weymouth, Mass. (1897.)
 Samuel M. Gray, Providence, R. I. (1890, 1896.)
 Goodridge attachment for oil boilers. (1891.)
 "Gem" boiler, Crawford & Saunier, Newark, N. J. (1891.)
 J. M. Glover, Baldwin, Long Island, New York. (1892.)
 James S. Gedeohn, Cleveland, Ohio; pipe boiler. (1892.)
 Griswold pipe generator, Henry Suttor. (1893.)
 E. U. Gibbs, Elmira, N. Y. (1894.)
 C. F. Gallion, Baltimore, Md. (1895.)
 T. W. Godwin & Co., Norfolk, Va. (1896.)
 Gas Engine and Power Company and Charles L. Seabury & Co.,
 New York, N. Y. (Types "E," "Alga," and "Enterprise," 1898;
 "Kanawha" type, 1899; "D improved" and "E improved," 1893.)
 See S—Charles L. Seabury & Co.
 Siren Galliher, Normal, Ky. (1893.)
 F. G. Gibson, Dorchester Mass. (1899.)
 Herreshoff, Bristol, R. I. (1873, 1878, and 1898.)
 S. P. Hedges, Greenport, N. Y. (1885, 1889, 1895.)
 Hazelton Company, water-tube porcupine boiler. (1886.)
 V. R. Hyde, Portland, Oreg.; the H. Statesmen boiler. (1886.)
 The Hartley boiler; presented by the Pioneer Iron Works, Brook-
 lyn, N. Y. (1887.)
 Hohenstein, Newark, N. J. (1890.)
 T. Hansen, Boston Mass. (1891.)
 E. Hayes, Rochester, N. Y. (1891.)
 F. W. Hyslop, New York, N. Y. (1892.)
 Gardener C. Hawkins, Boston, Mass. (1892.)
 H. J. Hancock, New York, N. Y.; Howard steam generator.
 (1893.)
 A. C. Harding, Chicago, Ill. (1893.)
 Henry Haenel, St. Augustine, Fla. (1894.)
 George H. Holmes, Gardiner, Me. (1894.)
 Hampden Hyde, Rochester, N. Y. (1894.)
 Heine safety boiler, by E. D. Meier, St. Louis, Mo. (1895.)
 George Harden, Detroit, Mich. (1895.)
 William H. Herbertson, Cadwallader, Pa. (1896.)
 Henry A. House, Bridgeport, Conn. (1897.)
 Henry E. Hull, Clinton, Conn. (1899.)
 George L. Haman, Detroit, Mich. (1901.)
 Gordon H. Hardie, Victoria, British Columbia. (1902.)
 C. W. Hawkes, Chicago, Ill. (1906.)
 Frank A. Hensley, San Antonio, Tex., porcupine boiler. (1906.)
 International Power Company, Providence, R. I. (1900.)
 Ernest A. John's boiler, New York, N. Y. (1892.)
 J. B. Jardine, San Francisco, Cal. (1894.)
 J. R. Jackson, McKeesport, Pa. (1894.)
 W. E. Jenkins and A. Stokey, Tacoma, Wash. (1900.)
 Geo. E. Jones, Newark, N. J. (1900.)
 Ernest N. Janson, Washington, D. C. (1901.)
 John R. Karstendick, New Orleans, La. (1884.)
 Charles L. Kraemer, New York, N. Y. (1898.)
 J. H. King, Daytona, Fla. (1899. Modification, 1900, presented
 by J. B. Sloan, Jacksonville, Fla.)

- Chas. Kellogg, Athens, Pa. (1900.)
 Geo. Krill & Bro., Baltimore, Md. (1900.)
 Charles H. Kimball, Plattsburg, N. Y.; "Kaelma" boiler. (1902.)
 C. W. Krotz, New Orleans, La. (1903.)
 Keep & Co., Portland, Oreg. (1904.)
 Lidback Manufacturing Company, Portland, Me. (1890.)
 J. Lacroix and Ed Rey, New Orleans, La. (1892, 1898.)
 Laughlen & Co., Pittsburg, Pa. (1893.)
 John H. Lutz, Michigan City, Ind. (1894.)
 J. H. & J. D. Lucas, St. Louis, Mo. (1895.)
 L. W. Loomis, Carrollton, Ill. (1896.)
 William H. C. Lyons, Philadelphia, Pa. (1896.)
 Paul W. Lichtenberger, Philadelphia, Pa. (1897.)
 Luippold Bros., Buffalo, N. Y. (1897.)
 Geo. Lawley & Son Corporation, Boston, Mass. (1900.)
 Harry Lawson, Jersey City, N. J. (1900.)
 Joseph C. Lesley, St. Albans, Vt. (1900.)
 S. C. Lighthill, Allegheny, Pa. (1900.)
 W. S. Lowe, Lima, Ohio. (1900.)
 L. A. Langmaid, Bath, Me. (1901.)
 Harry Lawson, New York, N. Y. (1904.)
 U. G. Lee, Chicago, Ill. (1904.)
 Locomobile boiler, presented by The Locomobile Company of America, Chicago, Ill. (1904.)
 E. W. Millard, Troy, N. Y. (1889.)
 C. B. Mosher, Amesbury, Mass. (1891.)
 "McQueen" boiler; Sullivan & Ehler, Albany, N. Y. (1891.)
 The Morrin Climax steam generator, Clonbrock Steam Boiler Co., Brooklyn, N. Y. (1891. Improved boiler, 1902.)
 T. F. Morrin's pipe boiler; J. Castleman, Brooklyn, N. Y. (1898.)
 T. F. Morrin, Brooklyn, N. Y.; horizontal and vertical types of water-tube boiler. (1900.)
 Frank Mahoney, New York, N. Y.; a horizontal boiler and a vertical boiler. (1892.)
 McBride Bros.' boiler, Philadelphia, Pa. (1892.)
 C. McDonagh, Hancock, Mich. (1892.)
 E. A. Magee, Brooklyn, N. Y. (1893.)
 Joseph Mohr, Chicago, Ill. (1893.)
 I. G. Morgan, Seattle, Wash. (1894.)
 W. W. Moore, Eugene, Oreg. (1894.)
 R. Munroe & Son, Pittsburg, Pa. (1894.)
 E. D. Meier, St. Louis, Mo.; Heine safety boiler. (1895.)
 J. H. Mittendorff, Washington, D. C.; H. E. Frauz steam generator. (1895.)
 W. J. McCaffrey and Charles Hilbert, Sing Sing, N. Y. (1895.)
 John Mohr & Sons, Chicago, Ill. (1896.)
 August Miller, Jefferson Parish, La. (1897.)
 G. F. Martin, St. Joseph, Mich. (1897.)
 George F. Martin, Benton Harbor, Mich. (1898.)
 George H. Mallett, West Chester, N. Y. (1898.)
 J. W. McQueen, Detroit, Mich. (1899.)
 Edward J. Moore, Philadelphia, Pa. (1899.)
 Tug *Maytham*, Houghton, Mich.; copper fire furnace, special. (1899.)

- Walter MacFarlane, Seattle, Wash. (1900.)
 Marine Iron Works, Chicago, Ill. (1901.)
 Philip J. Miller, Annapolis, Md. (1903.)
 James McCartney, Mobile, Ala. (1904.)
 Charles D. Mosher, Mosher Water Tube Boiler Company, New York, N. Y., types A and B. (1904.)
 Northrop Manufacturing Company; Copeland boiler, when composed in all its parts of wrought iron, copper, brass, or steel. (1888.)
 Niclausse water-tube boiler; William Cramp & Sons, Philadelphia, Pa. (1897.)
 New York Safety Steam Power Company, New York, N. Y.; the Worthington boiler. (1891, 1897.)
 New York Shipbuilding Company, Camden, N. J. (1902.)
 Nott marine boiler, Nott Fire Engine Company, Minneapolis, Minn. (1906.)
 Ofeldt's, Newark, N. J. (1889.)
 Marvin E. Otis, Rochester, N. Y. (1891.)
 William Oldman, jr., Buffalo, N. Y.; horizontal and vertical boilers. (1896, 1897.)
 Charles Ogle and James Hall, Jeffersonville, Ind. (1897.)
 F. W. Ofeldt & Sons, Brooklyn, N. Y. (1901.)
 James E. Orme and Henry H. Orme, St. Paul, Minn. (1902.)
 Pioneer Iron Works, Brooklyn, N. Y.; the Hartley boiler. (1887.)
 "Passaic" boiler, Crawford & Saunier, Newark, N. J. (1890.)
 M. H. Plunkett, boiler, Nos. 1 and 2, Baltimore, Md. (1892.)
 Perkins & Richmond, Grand Rapids, Mich. (1894.)
 Frank Printz, New Orleans, La. (1895.)
 Charles S. Parker, Orange, Tex. (1895.)
 R. C. Price, Allegheny, Pa. (1895.)
 George E. & Charles A. Painter, Pittsburg, Pa. (1896.)
 William E. Plummer, jr., Buffalo, N. Y. (1896.)
 Joseph Provuncher, East Providence, R. I. (1896, 1898.)
 D. A. Park, Brooklyn, N. Y. (1897.)
 Dr. E. L. Parker, Detroit, Mich. (1898.)
 J. E. Parker, Chicago, Ill. (1900.)
 Archibald Pifer, Braidentown, Fla. (1900.)
 Parker Engine Company, Philadelphia, Pa. (1901.)
 Thomas B. Perkins, Grand Rapids, Mich. (1901; improved porcupine boiler, 1903.)
 S. T. Powers, New Orleans, La.; porcupine boiler. (1903.)
 Pearson Manufacturing Company, Allegheny, Pa.; Pittsburgh boiler. (1904.)
 E. E. Roberts, New York. (1883.)
 Rochester Machine Tool Works, Rochester, N. Y.; Braggin's boiler (1889, 1894); Buckley patent water-tube pipe boiler (1896).
 Martin R. Ruble, Newark, N. J. (1891.)
 F. J. Robinson, Detroit, Mich. (1891.)
 D. Rousseau, New York, N. Y. (1894.)
 C. Reinhardt, Baltimore, Md. (1895.)
 Roberts water-tube boiler, New York, N. Y. (1883); improvements in boiler (1895); types F, G, H, and I (1897).
 J. B. Rives, St. Paul, Minn.; Waterous boiler. (1896.)
 Phil Rohan, St. Louis, Mo.; Western water-tube boiler. (1898.)
 Jacob Ruf, Newark, N. J. (1899.)

- T. W. Rucker, St. Louis, Mo. (1899.)
 Erdix Rounds, Owensboro, Ky. (1900.)
 A. L. Rhodes, West Superior, Wis. (1902.)
 Racine Boat Manufacturing Company, Muskegon, Mich.; Racine water-tube boiler. (1904.)
 Risdon Iron Works, San Francisco, Cal. (1904.)
 Josiah Robinson, Watervliet, N. Y. (1904.)
 The Shipman boiler, for using petroleum. (1886.)
 The H. Statesmen boiler, presented by V. R. Hyde, Portland, Oreg. (1886.)
 James B. Stead; sectional water-tube boilers, Nos. 1 and 3. (1888.)
 Charles L. Seabury, Nyack, N. Y. (1889, 1891, 1894, 1895, 1897.)
 See G, Gas Engine and Power Company and Charles L. Seabury & Co.
 W. J. Sanderson's, Syracuse, N. Y. (1890.)
 Harris K. Stroud's, Hastings, Minn. (1890.)
 Sullivan & Ehler, Albany, N. Y.; "McQueen." (1891.)
 Thomas L. Sturtevant, Boston, Mass. (1891, 1892, 1895.)
 Shortt Duplex Boiler Company, New York, N. Y. (1892.)
 W. D. Smith, Detroit, Mich. (1892.)
 Henry Sutter, Griswold pipe generator and Sutter sectional porcupine boiler. (1893.)
 Stillman Saunders, Providence, R. I. (1893.)
 Seachrist & Parker, Erie, Pa. (1893.)
 Lewis Saunders, Lawrence, Mass. (1894.)
 Lee H. Stevens, New Albany, Ind. (1894, 1895.)
 B. T. Squier, New York, N. Y. (1895.)
 William Skelton, jr., Buffalo, N. Y. (1895.)
 Halcyon Skinner, Yonkers, N. Y. (1895.)
 Horace See, New York, N. Y. (1895); improvements Nos. 1 and 2 (1904).
 Jacob H. Smith, Baltimore, Md. (1895.)
 Isaac E. Shepardson, Providence, R. I. (1896.)
 Speedy type Thornycroft pipe boiler, Thorpe, Platt & Co., New York, N. Y. (1897.)
 Richard Spreckels and Walter J. Wayte, San Francisco, Cal. (1898.)
 Charles Stillwell, Hampton, Va. (1898.)
 Wallace Stebbins & Sons, Baltimore, Md. (1900.)
 The Schaffer Machine and Manufacturing Company, Baltimore, Md. (1902.)
 George W. Swartz, Decatur, Ala.; porcupine boiler. (1902.)
 Emil Santsche, Eureka, Cal.; porcupine boiler. (1903.)
 Salamandrine boiler, manufactured by the Salamandrine Boiler Company, Newark, N. J., presented by H. L. Ricks, Eureka, Cal. (1903.)
 Schwing & Greaud, Gramercy, La. (1904.)
 J. A. Shaw, Newark, N. J. (1904.)
 Smith patent boiler, presented by E. J. Codd, Baltimore, Md. (1904.)
 G. E. Tregurtha, Boston, Mass. (1890, 1892.)
 Taylor Bros., Trenton, N. J. (1893.)
 B. Louis Toquet, Westport, Conn. (1893, 1894.)
 H. H. Taylor, Detroit, Mich. (1895.)
 Taylor boiler, Detroit Screw Works, Detroit, Mich. (1898.)
 Taunton Automobile Company, Taunton, Mass.; porcupine boiler. (1903.)

- Tabrett & Lewin, San Francisco, Cal. (1903.)
 W. J. Tierney and William Marquez, New Orleans, La. (1895.)
 Winthrop Thayer, Boston, Mass. (1897.)
 Thorpe, Platt & Co., New York, N. Y.; Thornycroft pipe boiler,
 "Daring" and "Speedy" types. (1897.)
 W. M. Towers, Rome, Ga. (1897.)
 W. C. Thompson, Philadelphia, Pa. (1897.)
 John Trasher, New Orleans, La. (1902.)
 William R. Thropp, Trenton, N. J. (1906.)
 Towne water-tube boiler, presented by Benjamin T. Squier, Brook-
 lyn, N. Y. (1906.)
 Emil Volk, New York, N. Y. (1894.)
 J. E. Vincent, Palatka, Fla.; a water-tube boiler and a porcupine
 boiler. (1902.)
 Charles Ward, Charleston, W. Va. (1883); coil boiler and "Navy"
 horizontal pipe boiler (1894); Ward's torpedo-boat boiler, Ward's
 torpedo-boat boiler No. 2, Ward's straight-tube launch boiler (1895);
 Ward's Royal Arch or Navy boiler (1897).
 S. Waterhouse, Boston, Mass. (1884.)
 J. W. Walters & Co., sectional water-tube boiler. (1888.)
 Wadham, 1315 Third avenue, New York, N. Y. (1890.)
 Worthington water-tube boiler, New York Safety Steam Power
 Company, New York, N. Y. (1891, 1897.)
 George & James Warrington, Chicago, Ill. (1891.)
 C. A. Wilkerson, Lynn, Mass. (1892.)
 Wickes Bros., East Saginaw, Mich. (1893.)
 Warner & Papst, San Francisco, Cal. (1893.)
 George L. Wright, North Andover, Mass. (1894.)
 Samuel T. Williams, Baltimore, Md. (1894; modification, 1899
 and 1900.)
 D. Y. Williams, South Haven, Mich. (1894.)
 W. Frank West, Morris Heights, N. Y. (1895.)
 George Warrington, Chicago, Ill. (1895.)
 Waterous boiler, J. B. Rives, St. Paul, Minn. (1896.)
 R. Weston & A. M. Lemke, Saginaw, Mich. (1896.)
 George L. Whittington, Sea Isle City, N. J. (1896.)
 Charles P. Willard, Chicago, Ill. (1896.)
 Benjamin A. Wyatt, Boston, Mass. (1897.)
 Charles M. Weber, Cincinnati, Ohio. (1897.)
 Watson & Peterson, Kansas City, Mo. (1897.)
 Theodore H. Wyman, Sebec, Me. (1897.)
 James C. Wignall, Philadelphia, Pa.; Bretherton boiler. (1897.)
 Western water-tube boiler; Phil Rohan, St. Louis, Mo. (1898.)
 Egbert P. Watson, Elizabeth, N. J. (1898; modification, 1900;
 porcupine boiler, 1903.)
 Robert White, Brooklyn, N. Y. (1899.)
 Beder Wood, Moline, Ill. (1899.)
 George S. Wolf, West Dover, Ohio. (1901.)
 George Warrington, Chicago, Ill. (1902.)
 Yarrow water-tube boiler, New York, N. Y. (1892.)
 Yarrow type, No. 2, Wm. Cramp & Sons, Philadelphia, Pa.
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 Robert R. Zell & Co., Baltimore, Md. (1894.)

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